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An Assessment of an Experiment in Accelerating the Development of Nuclear Standards

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June 1980

Prepared for

ETIP

Experimental Technology Incentives Program
Center for Field Methods
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CENTER FOR FIELD METHODS

THE EXPERIMENTAL TECHNOLOGY INCENTIVES PROGRAM

The Experimental Technology Incentives Program (ETIP) of the National Bureau of Standards pursues an understanding of the relationships between government policies and technology-based economic growth. The pursuit of this objective is based on three premises:

- Technological change is a significant contributor to social and economic development in the United States.
- Federal, State, and local government policies can influence the rate and direction of technological change.
- Current understanding of this influence and its impact on social and economic factors is incomplete.

ETIP seeks to improve public policy and the policy research process in order to facilitate technological change in the private sector. The program does not pursue technological change per se. Rather, its mission is to examine and experiment with government policies and practices in order to identify and assist in the removal of government-related barriers and to correct inherent market imperfections that impede the innovation process.

ETIP assists other government agencies in the design and conduct of policy experiments. Key agency decisionmakers are intimately involved in these experiments to ensure that the results are incorporated in the policymaking process. ETIP provides its agency partners with both analytical assistance and funding for the experiments while it oversees the evaluation function.

Because all government activities potentially can influence the rate and direction of technological change, ETIP works with a wide variety of agencies, including those that have regulatory, procurement, R&D, and subsidy responsibilities. Programs are currently underway with the General Services Administration, Food and Drug Administration, Veterans Administration, Securities and Exchange Commission, Department of Energy, Environmental Protection Agency, Occupational Safety and Health Administration, and other Federal agencies as well as various State and local agencies.

The accompanying report was prepared under contract. Statements contained in this document represent the views of the originating organization and do not necessarily reflect those of the National Bureau of Standards.

Director
Center for Field Methods
National Engineering Laboratory
National Bureau of Standards
U.S. Department of Commerce

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AN ASSESSMENT OF AN EXPERIMENT IN ACCELERATING THE DEVELOPMENT OF NUCLEAR STANDARDS

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AN ASSESSMENT OF AN EXPERIMENT IN ACCELERATING THE DEVELOPMENT OF NUCLEAR STANDARDS

by

Jane P. Woodward
Stephen D. Garrity

December 5, 1979

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PREFACE

This paper assesses an experiment conducted by the Experimental Technology Incentives Program (ETIP) in conjunction with the Nuclear Regulatory Commission (NRC). This assessment was carried out as part of analytic support contracts awarded to The Urban Institute and the Performance Development Institute[1] by ETIP.

The purpose of the assessment is twofold:

(1) To review the experiment and examine whether further detailed evaluation is warranted, and

(2) To determine what lessons can be learned about the conduct of ETIP experiments in general.

The underlying intent throughout has been to uncover the facts about the experiments so that an objective, accurate assessment could be made. Information for the paper was gathered by reviewing available documentation on the project and on the organizations involved, and by interviewing individual participants. The original designers of the experiment have been very helpful in this regard. The results of the study represent the views of the authors and are meant as a critique of method, not the designers. The lessons learned from the assessment should help improve the design of future ETIP experiments.

ETIP's goal is to develop policy guidelines relating to the impact of government on industry and on technological change as well as a body of knowledge necessary for their effective use. To achieve these goals, ETIP has been carrying out experiments with regulatory agencies to develop a

1. Department of Commerce Contract #7-35822 to The Urban Institute, October 1, 1977 to December 31, 1978. Department of Commerce Contract #EO-78-3603 to the Performance Development Institute for October 1, 1978 to December 31, 1979.

knowledge base and policy recommendations on how regulatory processes can be changed to bring about the desired commercial impact and to improve the environment for technological innovation. Under its contract with ETIP, The Urban Institute and the Performance Development Institute have provided analytic and data collection support.

One assumption underlying ETIP experimentation is that the rate and direction of private sector activity is influenced by the regulatory process. ETIP also assumes that innovation plays a leading role in economic and social growth. A final assumption is that administrative experimentation will lead to better understanding and control of the regulatory processes involved.

A major focus of ETIP's work is on the regulatory development process. This process often involves lengthy time delays, known as "regulatory lag." One example of the lag problem exists in the nuclear regulatory field, where the Nuclear Regulatory Commission (NRC) adopts standards for the licensing of nuclear reactors.

The NRC's mandate is to assure that non-military uses of nuclear materials and facilities are consistent with the laws governing the public health and safety, environmental quality, national security and antitrust. The NRC implements this mandate through the licensing of nuclear materials and facilities and the conduct of programs to ensure compliance. Standards for nuclear plants are included in regulations or regulatory guides for companies seeking nuclear power plant licenses.

ETIP's selection of the NRC and the standards-setting process was based upon public concern with energy problems and with the costly delay in the licensing of nuclear power plants. The absence of standards for nuclear power plants was thought to contribute to such delays. Thus the goal of the ETIP project described in this report was to explore ways to hasten both the establishment of standards and their adoption by the NRC.

EXECUTIVE SUMMARY

In March 1974, the Experimental Technology Incentives Program (ETIP) working in conjunction with the Nuclear Regulatory Commission (NRC) and the American National Standards Institute (ANSI) completed a project plan to experiment with accelerating the initial drafting of nuclear power plant standards by drafting subcommittees. These drafting subcommittees were staffed by volunteers from private industry and government, as part of the voluntary standards development process. The plan outlined the following activities:

1. ETIP was to prepare a project plan to test the following four changes from the normal standard drafting process for three or four standards (each standard was to be one experiment):

   --Hiring a full-time working group chairman,
   --Providing consultant services for data collection/correlation,
   --Providing clerical/technical editing services,
   --Conducting extended working meetings, possibly up to 14 days.

2. ETIP would obligate funds for the experiments for NRC use.

3. NRC would contract with ANSI to conduct experiments.

4. ANSI would hire a project manager to coordinate the individual experiments and monitor the effects of the projects on the development of standards.

5. Each experiment would differ in terms of the variables tested, (see #1 above), although the committees could choose the variables to be tested.

6. ETIP would contract with an evaluator to conduct a project evaluation, to assess:

   --whether standard development schedules were met,
   --quality of standards produced,
   --whether a more effective/efficient use of working group members resulted,
   --whether drafting time reduction offset project costs.

7. ETIP would conduct further research as needed, depending on results.

The standard-drafting experiments were expected to accelerate the production of draft standards, which in turn was expected to accelerate the production of final standards and their ultimate adoption by the NRC. If the project was successful, multiple benefits (e.g., reduction of nuclear reactor licensing delays and industry costs) were anticipated.

The purpose of this report is to describe and assess the experiments conducted, to report the lessons learned from the project, and to review the usefulness of further research. It is based on an open, objective inquiry about the facts of the project. To the extent possible, the findings from the assessment are included in the report so that readers can understand the project and draw their own conclusions.

A. THE EXPERIMENTAL INTERVENTION

The actual intervention conducted varied from the initial plan. ANSI hired two contractors to conduct the experiments. Battelle-Northwest (contractor #1) undertook experiments with three separate subcommittees. The variables tested included:

--Use of a concentrated five-day working meeting to draft the standard (instead of several one or two-day sessions, held over many months).

--Premeeting preparation of a working draft outline.

--Provision of an executive secretary/coordinator.

--Provision of clerical/duplicating support.

--Payment of working group chairmen.

--Payment of travel and living expenses of work group members.

--Holding of preliminary organizational meetings before the five-day working session.

--Limiting working group membership to 10 members.

Anderson, the second contractor, limited his experiment to the provision of secretarial support to the subcommittees involved. Each of the contractors submitted reports on their project experiments, but these were not intended to be comprehensive impact evaluations. Impact evaluations were planned by project designers, but were not funded due to complications in contracting and program changes in ETIP.

B. ASSESSING THE NUCLEAR REGULATORY EXPERIMENT

Three criteria were identified in the project plan as important in evaluating project success:

- Length of time required to produce the standard (as compared to "normal" time requirements).
- Quality of the standard produced.
- Cost.

The Battelle and Anderson reports provided some information on these criteria even though the two reports were not intended to be comprehensive evaluations. The following sections review the data available on each criterion.

1. TIME

In the Battelle experiment, the time required to draft the three standards was considered to be faster than the norm for the production of draft standards. While the Anderson report provided insufficient detail to assess the results reported, that report also concluded that the experiment helped to speed production of draft standards.

Neither of the reports associated with the experiment traced the time required for the draft standard to proceed through the remainder of the standards development process. This trace would have been needed to determine

the overall time required to produce the finished adopted standard. Original plans had discussed doing this. However, even if the traces had been carried out, a comparison to normal conditions would have been difficult since it appears that little data is available on the normal time required to produce a standard.

2. QUALITY

No precise criteria exist for evaluating the quality of standards produced through the voluntary standards process, and none of the reports associated with the experiment attempted to assess the quality of the standards produced. The evaluation study which had been projected to assess standard quality was never contracted out.

3. COST

Neither report indicated exactly how the money was spent or allocated among the experimental variables. It was thus impossible to identify the cost of implementing the individual variables.

C. LESSONS LEARNED

Three experimental changes--provision of secretarial assistance, clerical/duplicating support, and the five-day work week--were reported to have accelerated the initial drafting process. The evidence supporting these claims is weak, however, and the effect of these changes remains unknown. Nevertheless, there were important lessons learned from the experiment, and these relate to the experimental process rather than to the outcomes of the experiments conducted.

1. THE KNOWNS

There were a number of problems in the experiment:

- As a result of having to transfer funds through the NRC and ANSI, ETIP was unable to maintain close control over the design, development and implementation of the experiments.

- Because of planning and funding delays, the evaluation originally planned to assess project outcomes and impacts did not take place.

- Information provided by contractors on key project variables and outcomes was incomplete.

- The design initially chosen for the project was limited in the amount of information it could actually provide.

- The initial design did not clearly lay out how the proposed experiment fit into the major ETIP research needs, or into the overall standards development process.

- No background information was collected at the outset to initially check the validity of the experimental assumptions. A questioning of these assumptions by ETIP staff might have permitted a more defensible targeting of the experimental resources, and questions about the project's relevancy could have been better addressed both during the experiment and afterward.

2. THE UNKNOWNS

Because of the problems with experimental design and the lack of a comprehensive, follow-on evaluation, much remains uncertain at this time about the impacts of the experimental changes. Little or no information was collected on such factors as:

- average time for standards drafting and processing,

- the role of existing standards in the plant licensing process,

- quality of the standards produced,

- cost of introducing the individual innovations, compared with normal production costs, and

- the details of the experiments conducted

It would be difficult and costly to obtain information on these factors at this point in the project.

3. USEFULNESS OF FURTHER STUDY

ETIP has several options relative to the conduct of further study on the voluntary standards program:

Option 1: Terminate the research at the conclusion of the present review.

Option 2: Fund a limited research effort to gather additional background information about the experiments conducted and their impacts (e.g., the costs of the individual innovations, the quality of the standards produced) as well as about the "normal" development process and time requirements in the nuclear standards area, with which to compare the experimental results.

Option 3: Fund a substantial research effort to identify the role of standards, if any, in accelerating nuclear plant licensing, using a research design and a contracting process which will address the difficulties experienced in the initial experiment. Assuming that standards are found to be a substantial factor in accelerating nuclear plant licensing, ETIP could consider the usefulness of investigating how and whether the voluntary standards process can be successfully accelerated to develop those standards.

Option 4: Fund an evaluability assessment of the usefulness of conducting further study of the voluntary standards process and the impact of standards on nuclear power plant licensing. This would involve collecting sufficient background information about the proposed research that the costs and likely results and benefits from pursuing the various research options could be assessed prior to committing funds to any particular research design.

It is the conclusion of this assessment that if further research is contemplated, Option 4 is the most highly recommended. The conduct of an evaluability assessment would provide ETIP with guidance as to the areas where

further research is desirable and likely to be fruitful. Option 1 is the alternative best choice if sufficient resources are not available to make it worthwhile to undertake an evaluability assessment.

4. SUMMARY

While the drafting process was accelerated, the research design and the lack of sufficient data to assess the experimental assumptions at the design stage produced an experiment that was unable to demonstrate whether the acceleration of the drafting stage accelerated the entire standards development process and subsequent NRC endorsement.

I. INTRODUCTION

In 1975, the Experimental Technology Incentives Program (ETIP) undertook an experiment to acccelerate the establishment of standards and their adoption as regulatory guides by the Atomic Energy Commission (now the Nuclear Regulatory Commission, or NRC). This particular experiment was selected because of political interest at that time with reducing nuclear plant licensing delays. Licensing delays were attributed in part to the absence of nuclear power plant standards. Accelerating the development of nuclear standards was expected to reduce such delays. Figure 1 below depicts the assumptions underlying the experiment.

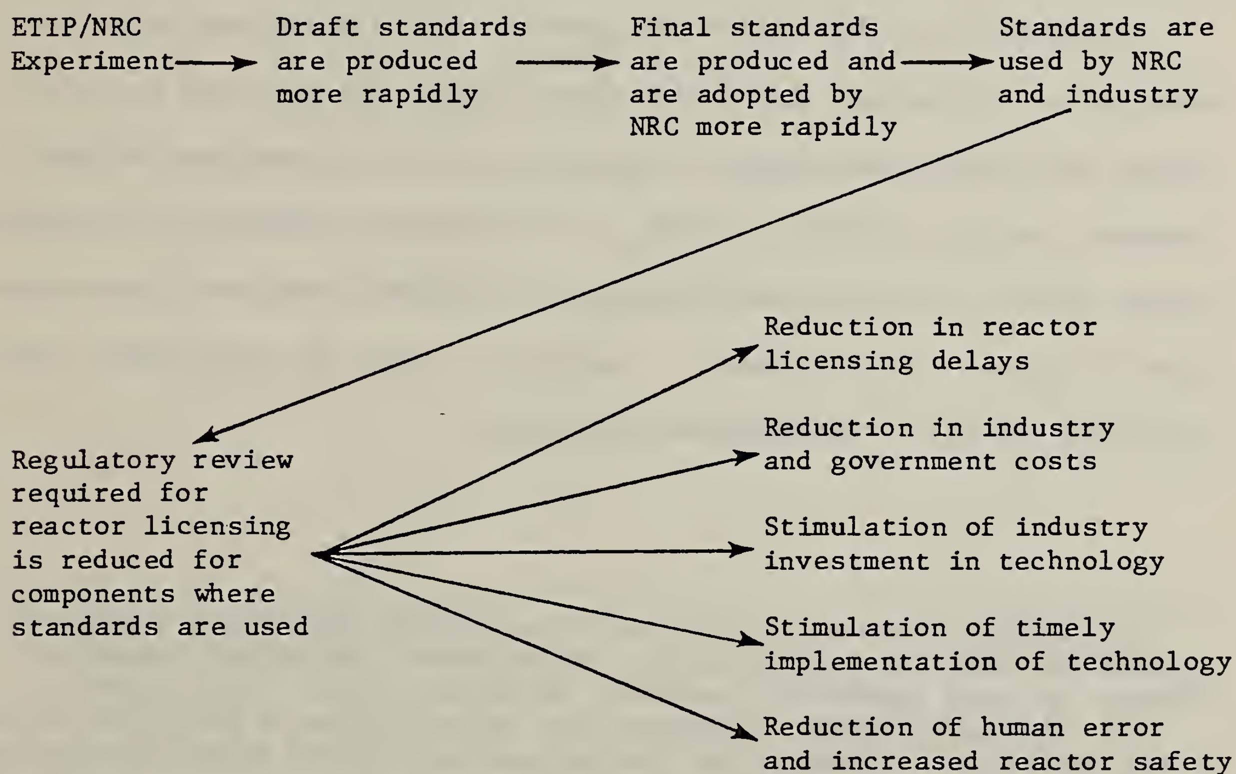

FIGURE 1: EXPERIMENTAL EXPECTATIONS

The project was viewed as only the first of a series of ETIP projects to examine the relationship between voluntary or industry-based standards and regulatory processes.

The purpose of this report is to describe the experiment conducted and its findings, and to depict how this particular experiment fit into the overall scheme of ETIP experimentation. It follows up on and in part relies on information gathered in an ETIP case study of the experiment conducted in 1976 and reported in January, 1977.[1] This report also purports to assess the overall effectiveness of the experiment and to pinpoint the problems encountered and how such problems might be avoided in the future, although it is not an evaluation of the experiment per se.[2] Finally, the report traces the standards produced as part of the experiments, and presents options for ETIP's consideration in terms of further study which might be undertaken.

Information for this report was gathered by reviewing available documentation on the project and on the organizations involved, and by interviewing individual participants. Individuals from the American National Standards Institute (ANSI), the NRC, the Experimental Technology Incentives Program (ETIP), and the National Bureau of Standards (NBS) were interviewed, either in person or by telephone. (Appendix A lists the individuals interviewed and the major documentation reviewed.)

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1. Garrity, Stephen, "A Review of the Nuclear Regulatory Experiment," unpublished draft, Washington, D.C.: Experimental Technology Incentives Program, National Bureau of Standards, January 11, 1977. See Appendix D.

2. ETIP had planned to contract out an evaluation to trace the impacts of the experiment. Planning for the evaluation occurred after the experiment had been initiated, however, and although money for the evaluation was obligated, no proposals submitted for the evaluation were funded.

The report is organized into several sections. Section II describes the context within which the experiment was conducted: the main players or "stakeholders," and their established roles in the voluntary standards process. Section III outlines the expectations held by the project planners when the experiment was initially designed: the assumptions which the experiment was intended to test. Section IV describes the project activities as they were reported by project documentation and the individuals interviewed, and the products produced. Section V then contrasts what was expected to occur with what, in fact, did occur, and describes what was learned from the experiment. The final section addresses major findings, what remains unknown, options for further study, and "lessons learned" from the experiment applicable to the design of future experiments.

II. CONTEXT OF THE EXPERIMENT: AN OVERVIEW OF THE VOLUNTARY STANDARDS PROCESS

The primary function of government agencies, such as the NRC, is to implement Congressional legislation. A crucial NRC mandate, for example, is to ensure "a high level of public health and safety and environmental protection in the design, construction, and operation of nuclear power reactors."[1] One means for carrying out this mandate is through NRC promulgation or adoption of standards for the licensing of nuclear reactors.[2] The NRC then includes these standards in its regulatory program as regulations or regulatory guides for companies interested in obtaining nuclear power plant licenses.[3]

The NRC's standards have been viewed as serving the following major purposes, to:

1. define information required from an applicant for license,
2. define acceptable levels of safety and environmental protection,
3. provide inspection and enforcement criteria,
4. limit contested issues in hearings,

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1. Testimony of Lester Rogers, Director of Regulatory Standards, U.S. Atomic Energy Commission, "Hearings on Reactor Safety before the Joint Committee on Atomic Energy," September 26, 1973, p. 1.

2. Standards can be defined as written specifications (codes and criteria) establishing minimum requirements for the technical design, construction and performance of specific products or for the conduct of specific activities.

3. As noted in the Rogers' testimony, regulations "set forth both general and specific requirements which must be met" by a licensing applicant. Regulatory guides, on the other hand, provide "guidance to applicants and licensees on ways acceptable to the regulatory staff of complying with the general and specific regulations" (see page 2). However, compliance with the regulatory guides is not required, if an alternative and acceptable way of complying with the regulations is proposed.

5. inform the public,

6. provide models and methodology for assessing levels of safety, safeguards, and environmental protection, and

7. help provide a basis for standardization of plants.[1]

The NRC can develop its own standards for inclusion in the regulations and regulatory guides. Alternatively, when it recognizes the need for a standard, the NRC may choose to adopt or adapt an existing standard if the needed standard already has been developed by an interest group (e.g., a particular industry or a consumer group). Where the needed standard has not yet been developed, the NRC can request that a standard be developed by submitting its request to a group such as the American National Standards Institute (ANSI). That request would be handled by the appropriate committee within ANSI--in this case of nuclear standards, the Nuclear Standards Management Board (NSMB). The NSMB would be responsible for coordinating the standard development effort, the end product of which would be submitted to the NRC (as was done in the experiment discussed herein).

A. ANSI AND THE VOLUNTARY STANDARDS PROCESS

Thousands of technical, product-related standards have been generated in the United States; over 8000 have been adopted by ANSI as American National Standards.[2] Many such standards have been generated by industry on a voluntary basis (as opposed to government-developed standards imposed through regulation). Over 400 trade associations, professional societies, and other similar interest groups (including consumer groups) have sponsored and coordinated the standards-development efforts. (Standard-setting may comprise from

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1. Testimony of Lester Rogers, p.1.
2. Interview with ANSI official.

10-30 percent of the typical association's activity.) This standards development process is known as the industry-based or voluntary standards system.

ANSI is a federation of standards-developing and standards-using organizations comprising approximately 900 companies and 200 trade, technical, labor, and consumer organizations. ANSI's main functions include managing and coordinating the voluntary development of national standards by its participating members, and approving such standards as American National Standards if they meet ANSI's consensus requirements. ANSI's standards development process emphasizes procedural fairness, a balancing of the interests represented at the drafting and review stages, and a consensus approach to standard adoption. According to an ANSI report:

> These (consensus) requirements ensure that all substantially affected interests have had an opportunity to participate in the standard's development or to comment on its provisions and that the standard has achieved general recognition and acceptance for use. Organizations that submit standards to ANSI for approval must supply evidence that these and related consensus criteria have been met. ANSI then conducts independent verification of the adequacy of consensus before acting on approval.[1]

Under the ANSI consensus approach, something greater than a majority but less than unanimity, is required. Any substantive objection to the standard must be reviewed and responded to by the drafting group. If the objecting party is not satisfied by the response, the objection accompanies the draft standard through the entire review process to publication. If the substantive objections are numerous and unresolvable, the standard must be withdrawn.

ANSI's public review or "canvassing" process can involve sending a proposed standard up to 14,000 individuals and groups, including media outlets and governmental agencies. Standards which survive the review process without

1. "ANSI Progress Report, 1977," New York: American National Standards Institute, March 1977, p. 1.

major substantive objections (or where the substantive objections are in the main resolved through standard revision) are adopted as American National Standards.

ANSI coordinates the standard-setting activities of its member groups. It is organized into a number of committees handling particular subject areas. For example, the Nuclear Standards Management Board (NSMB) is responsible for overseeing the nuclear standards program, including policy, financing, and recruiting.[1] Governmental or industry requests for particular standards (e.g., from the NRC) are funnelled through individual ANSI committees such as the NSMB. Generally at least one federal government employee is a member of such ANSI committees.

ANSI is dependant upon membership dues and the sale of its published standards for its main support, although it does receive some special project support. Less than 3 percent of its operating budget comes from government sources in the form of grants for specified programs.[2] One ANSI employee indicated that the government estimates the voluntary standardization process to cost over $500 million per year in volunteer labor.

Figure 2 below depicts the ANSI standard development process in summary form, showing the participants in the process and their respective roles. The process is described in greater detail in the following pages.

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1. Ibid, p. 12.
2. Ibid, pp. 11-13.

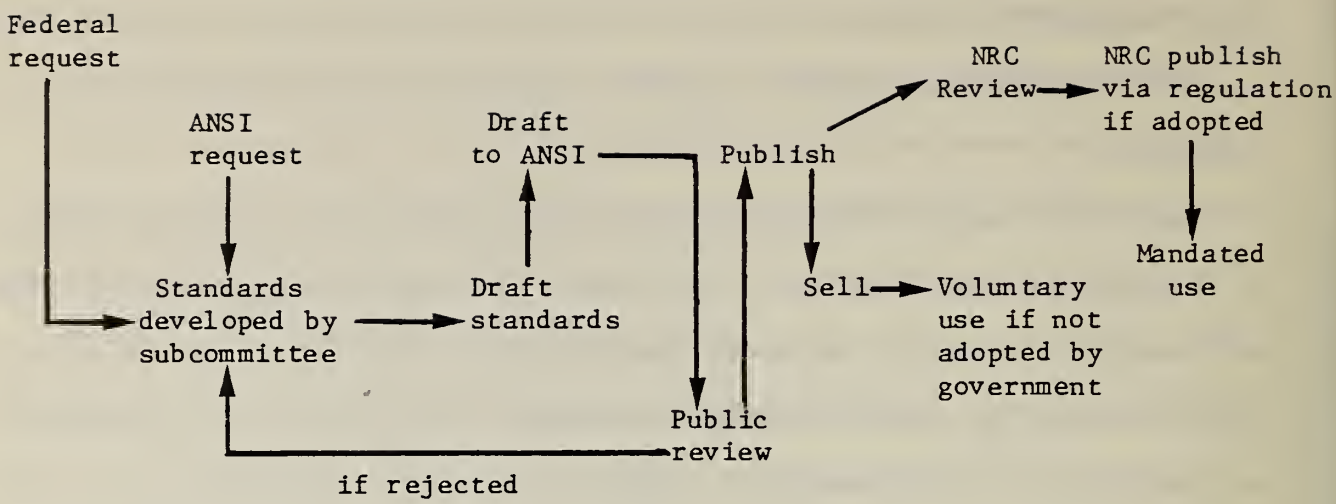

FIGURE 2: VOLUNTARY STANDARDS PROCESS UTILIZED BY NRC

B. STANDARDS PROCESS IN DETAIL

Interviews revealed that in the usual standard-setting process, the interest group which has "responsibility" over the standard area and which follows ANSI-prescribed consensus procedures works in cooperation with ANSI. The typical standard development pattern was described by ANSI staff and other participants as follows:

1. An entity (individual, group, government) proposes to an interest group or to ANSI that a standard is needed for an activity. If proposed to ANSI, the appropriate ANSI committee refers the standard to the appropriate interest group [e.g., the American Nuclear Society (ANS)]. The interest group is then responsible for seeing that the draft standard is developed in line with ANSI's procedureal requirements.

2. The interest group refers the matter to the committee responsible for the particular activity involved. If no committee is appropriate, the group notifies its membership, requesting those interested to volunteer to form a committee to draft the standard. If a sufficient number respond, the committee members are selected from those responding. (If too few respond, no action on the proposal is taken.) An effort is generally made to balance the various interests on the committee. A government official may or may not serve on the committee.

3. A subcommittee chair and members are selected as the writing group for the committee to prepare an initial draft of the standard. Draft preparation typically involves the following steps:

    a. The first one-day meeting: The initial meeting is mainly organizational, to discover interests, information needs, and how to organize knowledge. Sections to be drafted may be assigned to individual members.
    b. Second meeting held several months later: Section drafts are probably not completed; discussion focuses on resolving various interest conflicts and substantive issues.
    c. Third meeting held some months later: Section drafts circulated in advance are discussed, issues/interests worked on.
    d. Additional meetings are held.[1]
    e. The working group votes on/accepts the draft.[2]

4. The draft standard is submitted to the full committee for voting. (Objections are responded to by the writing group.)

5. The draft standard (if accepted by the full committee) is submitted to the interest group membership as a whole for voting. (Objections are responded to by the writing group.)

6. The draft standard (if accepted by the interest group) is submitted to ANSI for canvassing (submission for public review and comment by the 14,000 individuals and organizations on its review list.) Comments are returned to the writing group for response.

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1. The number of meetings required and the length of time between meetings typically depends on such factors as the status of knowledge about the activity (whether studies need to be conducted or the activity has been studied and knowledge is fairly well codified), the extent of controversy about the activity, practices of the interest group involved, use or non-use of the consensus approach, the urgency of need for the standard, etc. Meetings are generally several months apart, since they must be fitted in on a volunteer basis on time contributed by the individuals involved and expenses underwritten by the companies or governmental entities employing the individuals. An interest group staff member may or may not be assigned to provide administrative, logical, and clerical support.

2. An interest group typically has certain required voting procedures as well as an appeals process at each voting level. For example, the voting procedures may require that 80% of the members vote, and that 70% of the votes be positive. In addition, where the voluntary consensus process is used, the rules generally require that all objections be examined and responded to, and a rationale provided for why the objection is being overruled if the objecting party is not satisfied with the writing group's response. If the objecting member is dissatisfied, the member may appeal the group's decision, with the final level of appeal being a decision by the board of directors for the particular interest group. Rejection at any level throws the standard back to the writing group to respond to the objections raised.

7. The writing group responds to the comments by making revisions or providing a rationale for why revision is not appropriate.

8. ANSI reviews the comments and responses and determines whether ANSI consensus criteria are met, permitting standard adoption.[1]

9. ANSI adopts and publishes the standard as an American National Standard (if consensus criteria are met). Interested parties (including the government) may purchase and use the standard.

10. The pertinent government agency (e.g., the NRC) reviews the ANSI standard. (An optional step for the agency.)[2]

11. The agency endorses the standard, fails to endorse the standard, or endorses the standard with exceptions. If endorsed or endorsed with exceptions, the standard is incorporated as part of a regulatory guide or as a regulation. (If not endorsed, the agency may request revisions or draft its own standard.)

12. Those regulated (industry groups, manufacturers, licensees) are required (if the standard is made a regulation) or encouraged (if the standard is incorporated in a regulatory guide) to use the standard endorsed by the government agency.

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1. ANSI's consensus approach is described on page 5, i.e., the requirements of greater than majority approval and subcommittee response to all substantive objections raised.

2. The NRC's Director of Regulation has made a commitment that an ANSI-approved nuclear standard will be reviewed and action taken to implement the standard within 90 days, or ANSI will be informed why adoption did not occur.

III. THE EXPERIMENTAL INTERVENTION

The goal of this project was to accelerate the establishment of standards and their adoption by the NRC as regulatory guides. The expectation of the project planners was that by altering the conditions under which the interest group drafting subcommittees worked, the time needed to draft the initial standard could be reduced. This time savings, in turn, was expected to reduce the overall time period required to produce a completed standard and get it adopted by the NRC. The project plan (see Appendix B) outlined the activities expected to occur as follows:

1. ETIP prepares project plan to test four changes from the normal standard drafting process, for 3 or 4 standards:

    -- Hiring full-time drafting subcommittee chairman
    -- Providing consultant services for data collection/correlation
    -- Providing clerical/technical editing services
    -- Conducting up to 14-day working meeting

2. ETIP obligates funds for the experiment for NRC use

3. The NRC contracts with ANSI to conduct experiments

4. ANSI hires project manager to coordinate project experiments and monitor effect of project on development of standards

5. Each experiment differs in terms of variables tested, although committees may choose variables to be tested

6. ETIP contracts with evaluator to conduct project evaluation to assess:

    -- Whether standard development schedules were met
    -- Quality of standards produced
    -- Whether a more effective/efficient use of working group members resulted
    -- Whether drafting time reduction offset project costs

7. ETIP conducts further research as needed, depending on results.

Figure 3 summarizes the typical steps for developing nuclear standards using the ANSI voluntary development process, and illustrates the point in that process where the project experimental intervention occurred.

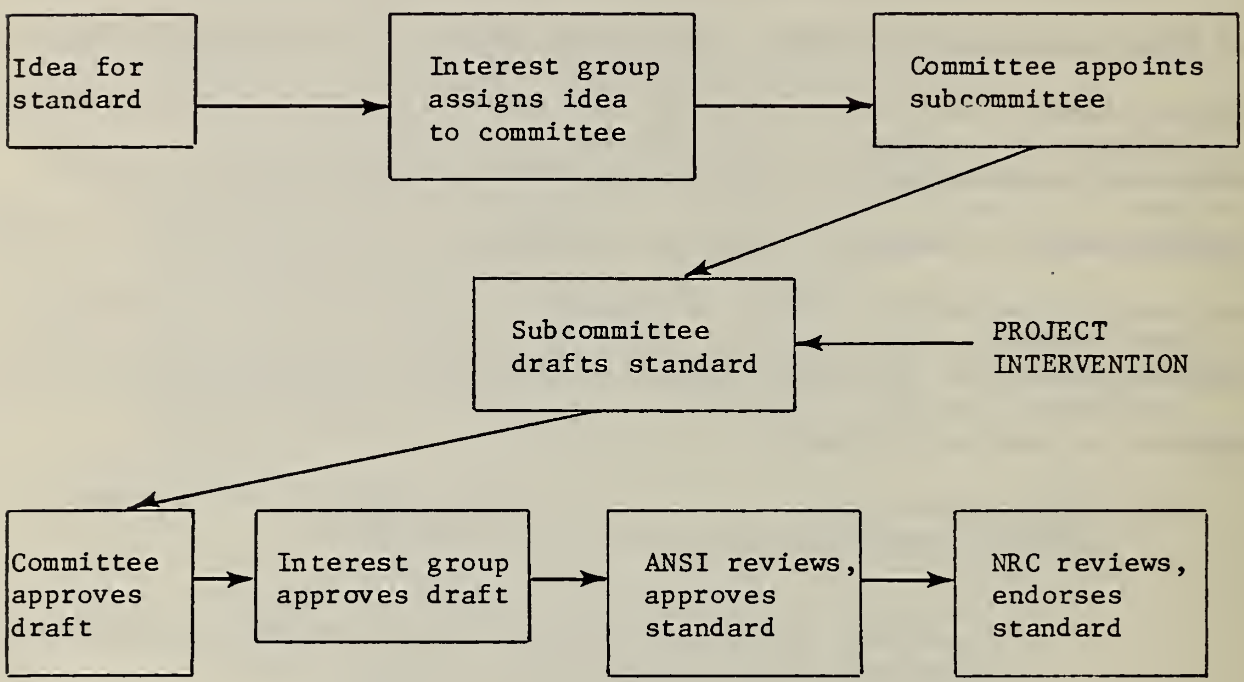

FIGURE 3: LOCATION OF THE PROJECT EXPERIMENT

The expectations underlying the experiment were most clearly outlined in the project plan for the proposed experiment (see Appendix B). These expectations are depicted in Figure 4. The accuracy of these expectations was reinforced by subsequent interviews by the author with ETIP, NRC, NBS, and ANSI staff members.

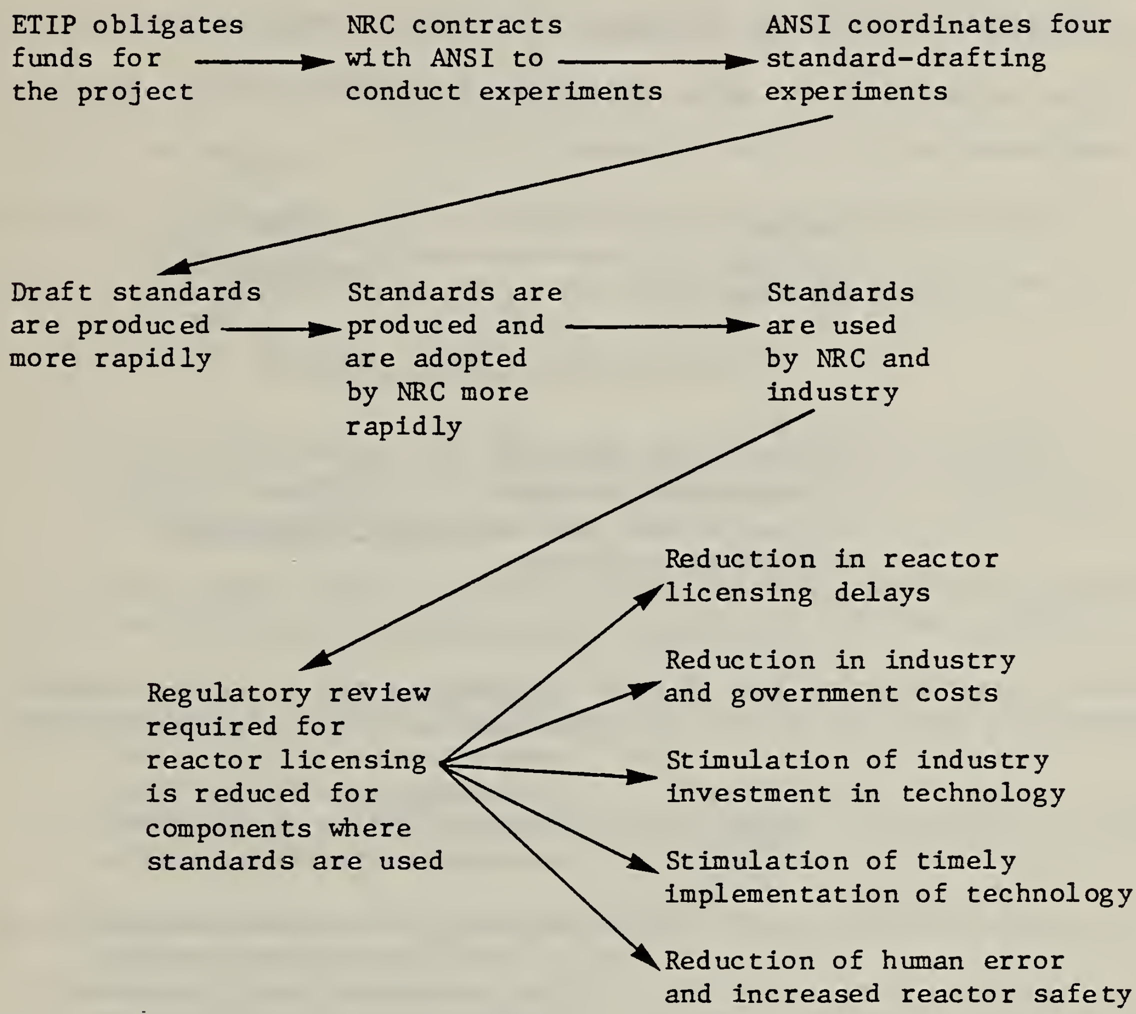

FIGURE 4: EXPERIMENTAL ASSUMPTIONS

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1. The major assumption underlying the voluntary standards process is that industry production of standards will produce greater likelihood of industry compliance. This assumption has not been empirically tested.

The experiments to accelerate the production of first-draft standards by altering drafting conditions also were foreseen as only one part of a larger experimental framework. As the initial project plan discussed, this was to be "the first of a series of projects" in which ETIP planned to "examine the relationship between voluntary, or industry-based standards and the regulatory process."[1] Figure 5 illustrates the additional research contemplated by ETIP and discussed in the project plan at the time of the initial experiment, of which this project was only a first step.

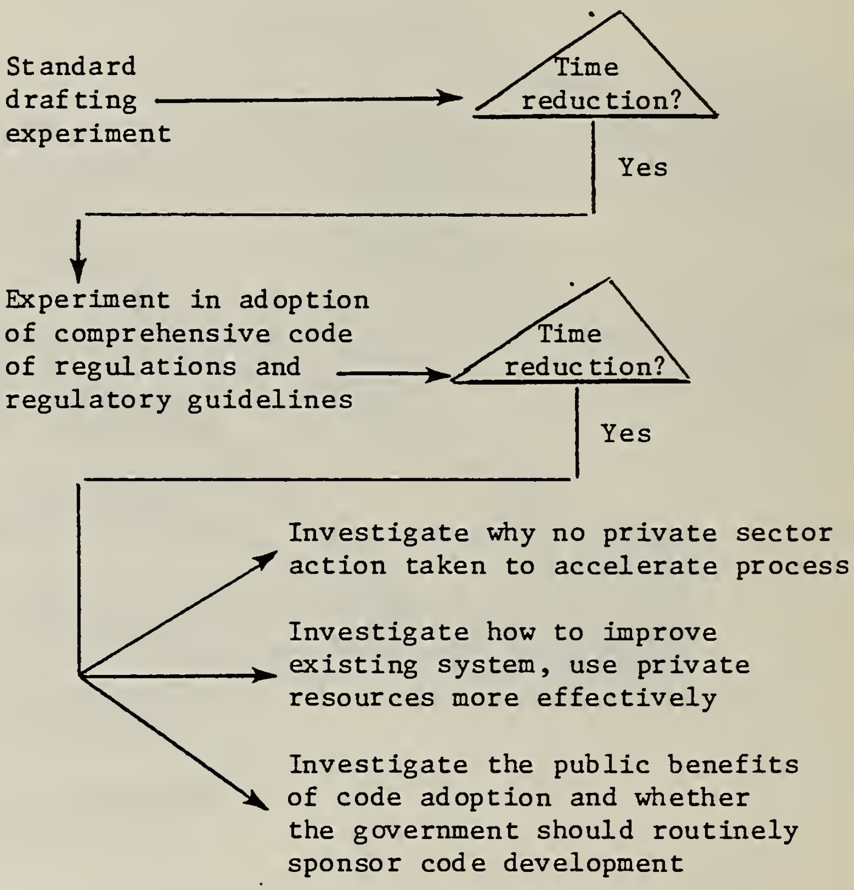


FIGURE 5: RESEARCH PROJECTED IF THE PROJECT PROVED SUCCESSFUL IN REDUCING DRAFTING TIME

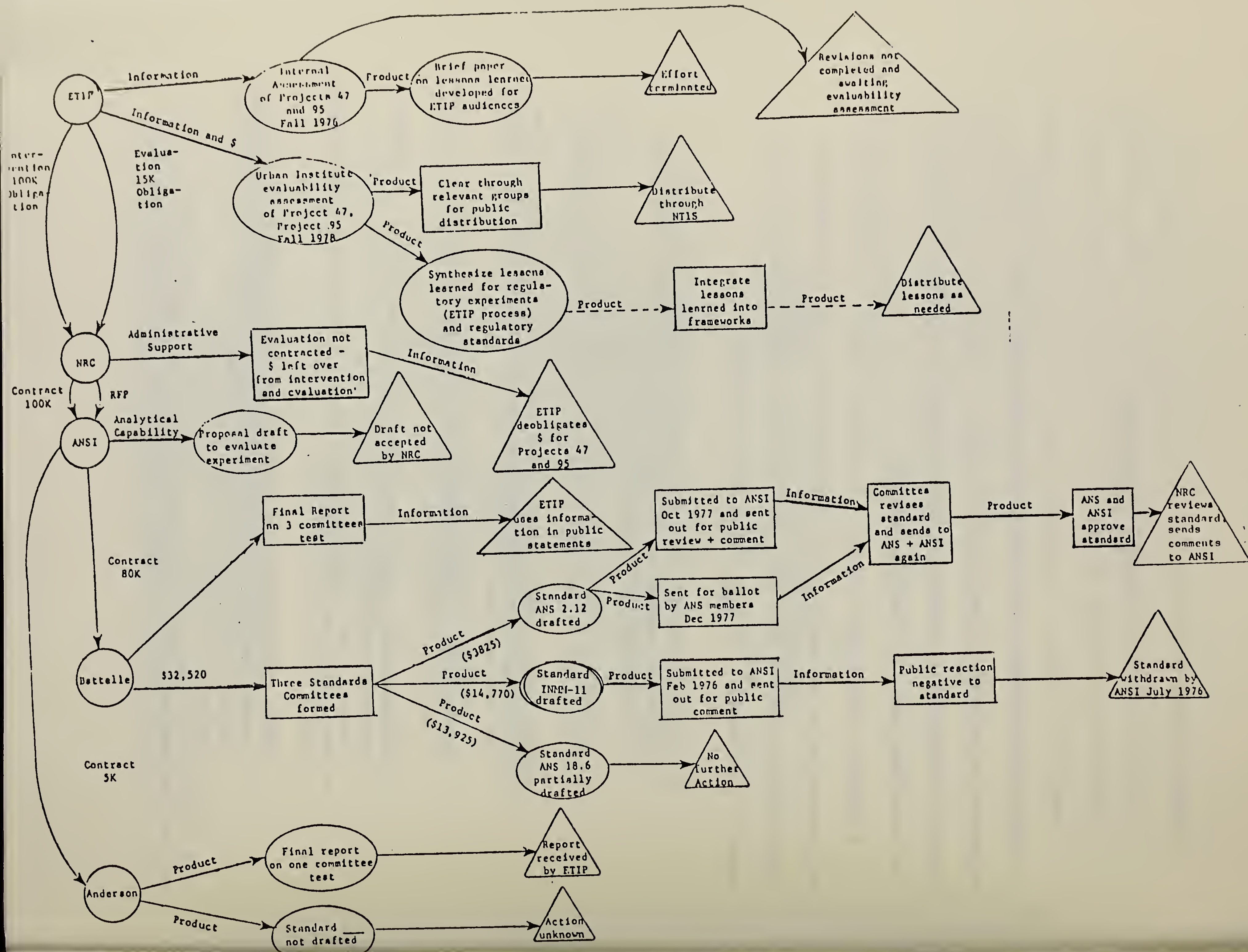
1. "Accelerating the Establishment of Standards and Their Adoption As Regulatory Guides by the Atomic Energy Commission," Project Plan, Washington, D.C.: Experimental Technology Incentives Program, March 21, 1974.

IV. PROJECT ACTIVITIES

The current research traced the actual project activities from their origins as far as direct results could be found. Figure 6 is a model of the project as it occurred, tracing the money obligated and spent, the activities undertaken, and the resulting products.

A detailed chronology of events and products related to the experiment was constructed by reviewing project documentation and by interviewing involved parties from the NRC, ETIP, NBS, and ANSI. This is reported as Appendix C. In summary, the main events were as follows:

- 1973-1974 -- ETIP, NBS, NRC, and ANSI discussed the joint project to accelerate the standards process; the project plan and guidelines were prepared.
- June 1974 — ETIP obligated project funds to the NRC to initiate the project in accordance with the project plan and guidelines.
- June 1974 — ANSI decided to contract out the experiment instead of hiring a program manager as specified in the plan, and amended the interventions to be made.
- October 1974 — ANSI contracted with Battelle-Northwest to coordinate three experiments.
- November 1974 — ANSI contracted with Harlan Anderson to conduct a fourth experiment.
- March, 1975 — ETIP developed a project plan for the project evaluation.
- 1975 — Experiments were conducted by Battelle and Anderson; no satisfactory contractor for the project evaluation was identified. Battelle submitted its report on the experimental process, with a subjective assessment by the participants.
- February 1976 -- Anderson submitted his report.



ETIP
Information
Internal Assessment of Projects 47 and 95 Fall 1976
Product
Brief paper on lessons learned developed for ETIP audiences
Effort terminated
Revisions not completed and awaiting evaluability assessment
Information and $
Intervention 100K Obligation
Evaluation 15K Obligation
Urban Institute evaluability assessment of Project 47, Project 95 Fall 1978
Product
Clear through relevant groups for public distribution
Distribute through NTIS
Product
Synthesize lessons learned for regulatory experiments (ETIP process) and regulatory standards
Product
Integrate lessons learned into frameworks
Product
Distribute lessons as needed
NRC
Administrative Support
Evaluation not contracted - $ left over from intervention and evaluation
Information
ETIP deobligates $ for Projects 47 and 95
Contract 100K
RFP
ANSI
Analytical Capability
Proposal draft to evaluate experiment
Draft not accepted by NRC
Final Report on 3 committees test
Information
ETIP uses information in public statements
Contract 80K
Battelle
$32,520
Three Standards Committees formed
Product ($3825)
Standard ANS 2.12 drafted
Product
Submitted to ANSI Oct 1977 and sent out for public review + comment
Product
Sent for ballot by ANS members Dec 1977
Information
Information
Committee revises standard and sends to ANS + ANSI again
Product
ANS and ANSI approve standard
NRC reviews standard, sends comments to ANSI
Product ($14,770)
Standard INMM-11 drafted
Product
Submitted to ANSI Feb 1976 and sent out for public comment
Information
Public reaction negative to standard
Standard withdrawn by ANSI July 1976
Product ($13,925)
Standard ANS 18.6 partially drafted
No further Action
Contract 5K
Anderson
Product
Final report on one committee test
Report received by ETIP
Product
Standard not drafted
Action unknown

- November 1976 — Funds for the project evaluation were deobligated, and no impact evaluation was conducted.

- 1976 -- A review of the Nuclear Regulatory experiment was conducted by ETIP staff and a case study report submitted in January, 1977.[1]

A. PROJECT ORIGINS

Early in 1973, ETIP was searching for viable experimental projects, partially through requests for "Qualifications and Interests" Statements. Dr. Jim Leiss, Director, Center for Radiation Research at NBS and member of the ANSI Nuclear Standards Management Board, proposed an experiment on accelerating the voluntary standards process in response to the requests. ANSI responded to ETIP's request for "Qualification and Interest" statements by suggesting the idea that ETIP reimburse their committee members for travel expenses. Although ETIP was not initially interested in these proposals, the discussions with ANSI led to contact with Lester Rogers, the Director of Regulatory Standards for NRC. Rogers wanted to improve the voluntary standards process at ANSI. This interest, plus an emerging political concern with reducing nuclear plant licensing lag, eventually stimulated ETIP's interest in the idea. From this time on, ETIP had continuing contact with Carl Johnson from the Regulatory Standards office.

ETIP's selection of the NRC and the ANSI volunteer standards process as a regulatory experiment was based on a strong public concern at the time with the U.S. energy problems and with the costly delay in the licensing of nuclear power plants. Licensing delays were attributed in part to the absence of nuclear power plant standards. An experiment which would test ways to speed up the development of standards was thus particularly attractive.

1. Garrity, Stephen, "A Review of the Nuclear Regulatory Experiment," unpublished draft, Washington, D.C.: Experimental Technology Incentives Program, National Bureau of Standards, January 11, 1977, See Appendix D.

B. PROJECT PLANNING

In March of 1974, ETIP completed a project plan for the NRC experiment. (See Appendix B.) The plan indicated that the NRC project was the first in a series of projects examining the relationship between voluntary standards and the regulatory process. The following four changes in the subcommittee standards-drafting process were proposed: paying a full-time committee chairman, using consulting services for information gathering, providing clerical and editing assistance, and using more lengthy meetings.

Under the plan, the Nuclear Technical Advisory Board (NTAB) in ANSI (established by the NSMB) would assist the NRC in managing the project. They were supposed to select standards and hire a program manager. The NRC would retain overall approval authority. While there was no interagency agreement between ETIP and the NRC because there was no actual transfer of funds, there were letters of commitment exchanged between them. ETIP held an account dedicated to the NRC project. ANSI would bill the NRC and the NRC would then bill the ETIP/NBS account.

In May, 1974, the project plan was approved, and $100,000 was obligated for NRC/ANSI use.

C. PROJECT PLAN CHANGES

Contrary to the project plan, ANSI decided to contract out the experiment, instead of hiring a program manager to coordinate the intervention and conduct the experiment. It is unclear who at ANSI or the NRC made this decision and why it was made. According to the ETIP review of the project, "ANSI . . . reworded the language of the plan specifying the interventions to be used.

These interventions became illustrative, leaving ANSI the option to suggest other interventions it felt important."[1]

Thus in June, 1974, ANSI issued a request for proposals for the experiment, and in August, Battelle-Northwest submitted a proposal to look at different variables in three committees. (The standards chosen for the experiment were selected partly because of the urgency of need for the particular standards.) A contract for $80,000 was signed with Battelle in October, 1974. Also in October, Harlan Anderson, from Westinghouse-Hanford Corporation, submitted a proposal to study the effects of one variable in a single committee. That proposal was funded in November for $5000.

D. EXPERIMENTS CONDUCTED

Four experiments were run using four different committees, each working on the drafting of a single standard. The changes from the normal committee operation included:

- Use of a concentrated five-day working meeting to draft the standard (instead of several one or two-day sessions, held over many months)
- Premeeting preparation of a working draft or outline
- Provision of an executive secretary/coordinater
- Provision of clerical/duplicating support
- Payment of working group chairmen
- Payment of travel and living expenses of drafting subcommittee members
- Holding of preliminary organizational meetings before the five-day work session
- Limiting working group membership to 10 members

1. Ibid., p.16.

Battelle-Northwest conducted experiments with three subcommittees, each subcommittee working on a different standard. These included:

Subcommittee	Standard
ANS 2.12	Guidelines for Combining Natural Phenomena and Manmade Hazards at Power Reactor Sites
ANS 18.6	Discharge of Thermal Effluents Into Surface Waters
INMM-11	Criteria and Standards for the Certification of Nuclear Materials Managers

Two of the subcommittees were subcommittees within the American Nuclear Society (ANS). One was a subcommittee of the Institute of Nuclear Materials Management (INMM). (Appendix E gives more detailed information on each of the experiments conducted.)

Each committee chair was permitted to select the variables to be tested; the variables chosen proved very similar. All three committees tested the five-day working meeting, use of an executive secretary, provision of clerical and duplicating support, and the limiting of the drafting subcommittee members to approximately ten. Two of the committees paid the chairmen and the travel and living expenses of the drafting subcommittee members. Two subcommittees had subcommittee members draft and prepare sections of an initial working draft, so that a working draft would be ready for use at the beginning of the five-day work session. One subcommittee had the paid consultant/chairman prepare a working outline for the work session. And two of the subcommittees had preliminary organizational meetings before the five-day work session was held.

Harlan Anderson focused on only one variable. Anderson was chairman of ANSI Committee N-11, and used the $5000 grant to pay for the provision of secretarial assistance to the very active standards-writing Committee on Fuel, Control, and Moderator Materials for Nuclear Reactor Applications (C-26) within the American Society of Testing and Nuclear Materials (ASTM). Anderson was also chair of the experimenting ASTM committee, and could directly observe the working sessions of the drafting subcommittees.

E. REPORTS PRODUCED

Battelle Northwest: Battelle-Northwest submitted a report on the experiments in September, 1975. In that report, Battelle provided information on:

- The experiment conducted, including the subcommittee members and the experimental variables tested,
- Costs of funding each subcommittee's changes, and
- Each subcommittee's subjective ratings, based on a five-point scale, of:
  — the usefulness of the specific innovations,
  — the appropriateness of the subcommittee composition,
  — skills of the chairman,
  — difficulty level of the standard,
  — overall subcommittee performance.

Battelle also furnished copies of the draft standards produced.

No information was provided on:

- Actual time for producing the standards,
- Standard quality,
- Follow-up on what happened to the standards, once drafted.

Harlan Anderson: Anderson submitted a brief report in February, 1976, including a discussion of:

- The variable tested,
- The background of the consensus standards process,
- His subjective assessment of results, based on his own observations and the comments and reaction of other committee members,
- Recommendations that further funding be provided,
- Project costs.

Copies of meeting minutes were also provided.

No information was provided on:

- Standards drafted, if any, or
- Actual time taken to produce standards.

F. PERSONNEL CHANGES

A number of personnel changes occurred at the NRC and ETIP during the course of the project. In December, 1974, Rogers, the Director of the NRC's Office of Regulatory Standards and the initial NRC supporter of the experiment, retired. In September, 1975, the original ETIP project monitor (Phil Harter) left. Also, Victor Berlin joined ETIP staff, and began discussing the need for a wider focus on ANSI's standards development process.

The precise impact of these changes is unclear. They did provide a certain discontinuity with previous project plans and implementation. In the author's opinion, they may have lessened the understanding of and support for the project both at the NRC and at ETIP. This was because of the uncertainties created over the value of the original project and the change of interests. At the minimum, project focus was somewhat changed.

G. PROJECT EVALUATION[1]

The initial plan for the project foresaw the conduct of an evaluation of the proposed experiment. During March of 1975, a project plan for the proposed evaluation was prepared at ETIP. The plan proposed to develop background information on the standards development process, and to prepare a detailed review of the experiment, including the postexperiment history of the standard drafts, the project costs and an identification of what recommendations could be made.

The evaluation plan was approved in April, 1975, and project funds were obligated in June. In December, ANSI sent out requests for proposals for the conduct of the evaluation, and in January, 1976, three proposals were submitted.

1. The details of this discussion were derived in large part from the ETIP Review of the experiment by Garrity, discussed below. See Appendix D.

None of the proposals was, however, accepted by the NRC, and in February, ANSI submitted a proposal to the NRC to conduct the evaluation itself.

Although the NRC attempted to put through sole-source contracting with ANSI for the evaluation, there proved to be insufficient justification for a sole-source contract. Although ANSI submitted a second and revised evaluation proposal in June, 1976, no NRC action was taken.

H. SUBSEQUENT FOLLOW-UP

In July, 1976, Steve Garrity joined the ETIP staff. At that time, he was requested to undertake a review of the nuclear regulatory experiment. After considerable investigation, the report based on his review was completed in January, 1977. In this report, Garrity described and then critiqued the experiments conducted. A copy of the Garrity report is attached as Appendix D.

ETIP requested that the current assessment of the project be conducted as part of the analytic support contract awarded to The Urban Institute in October 1977. A major purpose of this additional effort was to determine if further study was warranted.

V. ASSESSING THE ETIP/NRC PROJECT

Assessing the effectiveness of the nuclear regulatory experiment requires comparing the expected project activities and impacts (best summarized in Figure p. 12) with the project activities and impacts reported by the project participa and project documentation (discussed in Section IV). Figure 7 summarizes the events intended as contrasted to the events reported to have occurred.

A. PROJECT ACTIVITIES

As the comparison indicates, three basic changes occurred from the expected events:

- ANSI chose to subcontract the experiments rather than to conduct the experiments through the hiring of an in-house project manager.
- More variables were tested than were originally proposed.
- The evaluation of project impacts was not conducted. As a result, project impacts were not ascertained, and adequate descriptions of the experiments were not provided.

As a result of the changes in the project, the data actually collected and reported varied from what was expected in the initial project plan.

	INTENDED	REPORTED
1.	ETIP prepares project plan	Plan prepared (1973-74)
2.	ETIP obligates funds for NRC use	Funds obligated June 1974
3.	NRC contracts with ANSI	NRC contracts with ANSI
4.	ANSI hires project manager to coordinate experiments according to project plans	ANSI contracts with Battelle (October, 1974) to coordinate 3 experiments ANSI contracts with Anderson to conduct 4th (single-variable) experiment (November, 1974)
5.	Experiments conducted to test four variables	Experiments conducted; the 1-8 variables tested overlapped with the original 4.
6.	ETIP contracts out evaluation to assess impact of experiments	No evaluation contract awarded. Battelle submits report on experimental process, with subjective assessment by participants (1975). Anderson submits report with conclusions but no supportive data (1976).
7.	Draft standards are produced more quickly	Draft standards are produced more quickly
8.	Standards are produced and adopted by NRC more quickly	Not addressed by experiment
9.	Regulatory lag decreases, operational safety increases	Not addressed by experiment
10.	ETIP conducts additional research in area	ETIP conducts follow-up review of experiment (1976-1977)

FIGURE 7: INTENDED VS. REPORTED EVENTS

B. PROJECT IMPACTS

Three criteria were identified in the initial project plan as important in evaluating the success of the experimental project:

- Time required to produce the standard (as compared to "normal" time requirements).
- Quality of the standard produced.
- Cost.

The Battelle and Anderson reports provided little information on these criteria. However, the reports were not intended from the outset to be impact evaluations. What information was provided in those reports has been supplemented to the extent feasible by the follow-up conducted as part of the current review.

1. TIME TO PRODUCE THE STANDARD

a. TIME TO PRODUCE INITIAL STANDARD

None of the reports explicitly indicated the exact length of time required to produce the initial draft standard. It was possible, however, to reconstruc the time required for the Battelle standards.

Two of the Battelle subcommittees produced a draft standard by the end of the scheduled one-week working session. However, the subcommittee where no preliminary organizational meeting was held was unable to produce a completed draft by the end of the working session and subsequent sessions were required to get agreement on the first draft. The time required to draft the three Battelle standards, from the point of selecting the chairmen to completion of the draft standard, was 2+ months, 8 months, and 9 months respectively for the three standards.[1] The Battelle report as well as individuals interviewed as part of this review concluded this time to be faster than the norm for

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1. See footnote ** on Figure 8, p. 34.

production of draft standards, and thus concluded that the experiment was successful in terms of having accelerated the production of the first draft standard. Those NRC, ANSI, and NBS individuals interviewed indicated that the time for production of the initial draft standard in the nuclear area typically averaged from 1 to 2 years, and sometimes longer. One commented that the ANS in particular found it difficult to produce draft standards in a shorter time period, so that the 4 to 9-month time required by the ANS subcommittees to produce the two standards in the experiment was particularly distinctive.

It was difficult to tell what happened in the Anderson experiment. The report submitted was brief and included no description of the experiment conducted except that secretarial assistance had been provided. There was no evidence that the project traced the effect of providing secretarial assistance on the production of individual standards. Nonetheless, the Anderson report concluded that:

> It was the opinion of the officers and subcommittee chairmen of ASTM C-26 Committee that this experiment was very worthwhile and that it helped to speed up the nuclear standard activities of the Committee to produce final national consensus standards.[1]

b. TIME TO PRODUCE FINAL STANDARD

None of the reports associated with the experiment traced the time required for the draft standard to proceed through the remainder of the standards development process. When this was done as part of the current review, only one of the draft standards was found to have survived the review process. The time from the initial meeting of the drafting subcommittee to the adoption of the standard by ANSI was three years and ten months. The standard went to the NRC for review and adoption on August 8, 1978. The NRC did not adopt the standard, but sent

1. Anderson, H. J., "A Research Report, A Single Variable Experiment on Accelerating the Writing and Completing of National Consensus Standards." Final Report on part of ETIP Project #47 submitted to American National Standards Institute, Inc., New York, New York: February 27, 1977, p. iii.

its comments to the ANSI subcommittee on November 8, 1978. The committee's response has not yet been transmitted to the NRC. The time required for adoption by the NRC (if it is in fact adopted) remains unknown.

c. WEAKNESS OF THE "TIME" CRITERION

The "length of time" test is a difficult test to apply when assessing the effectiveness of a standard-drafting experiment. Factors other than the variables being tested may influence the time required to produce a standard and get it adopted by ANSI or an agency, such as:

-- the controversial nature of the activity proposed to be regulated by the standard, affecting the amount and length of associated debate and thus the length of time required to get consensus on the standard,

-- whether the state of knowledge about the activity is already far advanced, lessening the time required to produce the draft standard,

-- political sensitivity toward industry-produced standards, which may lead to distrust of such standards and a tendency of government personnel not to consider them,

-- the experience and skill of the particular interest group in managing the voluntary standards process,

-- the degree of prior experience the committee members designated to develop the standard had had in working together on previous standards,

-- the urgency of need for the standard (a factor of particular import to the experiment since ANSI selected high priority standards for the project).

In addition, little data appears to be available from elsewhere on the "standard" time to develop a standard. Since each standard is unique and typically developed by a separate group of people, and since interest groups follow somewhat different procedures, there is no single standard development process or standard development time to use for comparison.

2. STANDARD QUALITY

No precise criteria have been adopted for evaluating the quality of standards produced through the voluntary standards process--a problem for anyone interested in evaluating the impact of attempting to accelerate the standards development process. Possible tests proposed in the evaluation plan and by the interviewees included:

-- whether the standard is endorsed by the relevant government agency, and the number of exceptions made to the standard,

-- whether agency staff find the standard sufficiently comprehensive and as easy to use as practicable,

-- whether the standard is actually adopted and used by industry,

-- whether the standard is effective over time in achieving its goal, e.g., preventing accidents.

Tests proposed by those interviewed for evaluating the quality of the first draft standard included:

-- number of objections raised to the standard when reviewed at various stages of the standard approval process,

-- the length of time required for standard adoption by the various organizations (e.g., the interest group, ANSI, the pertinent agency).

None of the reports associated with the experiment attempted to assess the quality of the standards produced using the above-mentioned criteria, or any others. The evaluation study which had been projected to assess standard quality and might have possibly used these criteria was not contracted out.

a. FOLLOW-UP FINDINGS

The follow-up review of the standard's progress conducted for this report included no systematic attempt to assess the standards in terms of all of the above criteria. Follow-up was conducted by 1) discussing standard quality with some of the individual participants, and by 2) tracing what happened to the individual standards.

-- Opinions of interviewees: One NBS official indicated that those individuals with whom he had spoken following the experiment who had looked at the draft standards concluded that they were as good drafts as those which are produced using the normal drafting process.

One NRC drafting committee participant was of similar opinion. He indicated, however, that some individuals on the drafting subcommittees thought that accelerating the drafting stage was likely to prevent the subcommittee members from getting as much consideration and input from their companies, leading to more objections being raised at subsequent review stages and thus lengthening the post-draft review stage since less time was taken to get a consensus at the first-draft stage. The NRC official disagreed with this concern, however. He thought that the subcommittee members got as much input from their companies as through the normal process, since they maintained constant telephone contact with their home company experts during the five-day working session.

-- Tracing the progress of the standards to adoption: Only one of the standards (ANS 2.12) made it through the entire standards development process. The INMM-11 standard was sent back to the drafting committee pending further study. Reviewers of the standard at the ANSI canvassing stage concluded that sufficient information was not available on the appropriate criteria for materials control to permit the developing of standards for selecting materials control managers.

The ANS 18.6 standard was held back by ANSI and never sent out for review. The particular standard involved environmental impacts, and since recent standards relating to the environment had met considerable resistance from environmentalists and failed to make it through the ANSI review process, the ANSI review was postponed pending reevaluation of all the particular ANSI committee's standards.

The third standard (ANS 2.12) was successful. It was approved as an ANSI American National Standard in July, 1978, and sent to the NRC for comment on August 8, 1978. The NRC did not adopt the standard, however, but returned its comments to the drafting committee on November 8, 1978. No further action had been reported.

b. ASSESSMENT OF THE "QUALITY" DATA AND CRITERION

It is impossible to draw useful conclusions from the amount of data collected in the current follow-up. It would require a much more extensive survey of project participants and additional experts, as well as the development of more precise standards for comparing standard quality to enable a comparative assessment of standard quality. The development of such criteria would not be a simple task.

Since only one of the standards made it through the process to the NRC review stage, and factors other than standard quality were responsible for halting progress of two out of three standards, it would be impossible to apply several of the criteria proposed for assessing standard quality (e.g., endorsement by the government agency). Nonetheless, the draft standards evolved could be submitted for assessment to a group of experts familiar with standards development. It would also be possible to submit a sample of draft standards evolved through the regular drafting procedure to a similar assessment, to evolve comparative data.

Similarly, a survey could be conducted to determine the percentage of draft standards which normally survive the standards review process, to see if the one-third success rate experienced in the experiment was typical.

None of these paths appear to be desirable at this point in time.

An assessment of standard quality would be costly and time-consuming in light of the difficulty in establishing objective criteria and the time and effort required to trace the standards from the drafting stage through ultimate disposition.

3. COST OF ACCELERATING DRAFTING PROCESS

The Battelle report indicated the costs of introducing the innovations in each of the three subcommittess. (Figure 8 illustrates the variables introduced and the costs per subcommittee.) No comparison figures were either available or necessary, since in the typical drafting subcommittee situation, all costs are underwritten by the companies or governmental entities where the participants work. The cost of providing the secretarial services for the Anderson experiment was reported to be $5000, or equivalent to the grant amount. However, it is difficult to tell from either of the reports submitted exactly how the money was spent or to allocate the costs among the experimental variables. It is thus impossible to identify the cost of implementing the individual variables.

No additional cost information was gathered as part of the current review. If detailed records were kept by the two contractors, however, such information could be retrieved. It would also be possible to project such costs with little difficulty for most of the variables, e.g., cost of clerical support.

4. SUMMARY OF EXPERIMENTAL CONCLUSIONS

Authors of the Battelle report reported the following changes as successful, based on their observations and questionnaire data:

- Use of 5-day or longer working session,
- Use of preliminary organizational meetings prior to the working meeting,
- Premeeting preparation of an outline or preliminary draft by the working group members,
- Provision of an executive secretary,
- Provision of clerical and duplicating services.

Payment of the chairman or of the travel or living expenses of the members was not deemed particularly useful.

The Anderson report concluded that the provision of secretary services was also worthwhile and speeded up the overall process of getting standards generated and accepted.

In follow-up discussions, one ANSI staff member reported that in a January, 1978 meeting of the planning committee of the ANSI Nuclear Standards Management Board, attention focused on how DOE funding should be spent to accelerate development of fuel cycle standards. The American Nuclear Society (ANS) member in attendance reported that ANS had drawn the following conclusions based on ANS' experience with the nuclear standards project:

- Three innovations were of particular usefulness: provision of the executive secretary and of clerical and duplicating support, and use of a longer working session.
- Although in the normal course of events, money would not be available to support use of these innovations, these innovations would be implemented in instances where an agency or group needed a standard quickly and was willing to provide the funds needed to accelerate the standard development process.

Figure 8 summarizes the experimental variables tested in the Battelle and Anderson projects and the results reported.

	BATTELLE EXPERIMENTAL COMMITTEES ANS 2.12	BATTELLE EXPERIMENTAL COMMITTEES ANS 18.6	BATTELLE EXPERIMENTAL COMMITTEES INMM-11	ANDERSON COMMITTEE N-11
<u>Independent variables tested</u>				
5-day working meeting *	X[1]	X	X	
Pre-meeting preparation of				
Working outline *		X		
Working draft *	X		X	
Secretary provided *	X	X	X	X
Clerical/copying support *	X	X	X	
Preliminary meetings	X	X		
Paid chairman		X	X	
Paid member expenses		X	X	
Limited number	X	X	X	
<u>Dependent variables reported</u>				
Time	8 mos.	2+ mos.**	9 mos.	reported shorter than usual
Quality	-[2]	-	-	-
Cost	$3825	$13,925	$14,770	$5000
Participant opinions on:				
— usefulness of innovations	X	X	X	X
-- overall performance	X	X	X	X

* Those marked with an asterisk were reported effective in contributing to the standards drafting process.

** A partial draft was completed within 2+ months, but some sections remained to be drafted and had not been completed within the following two months. No information is available on the first draft completion date.

1. The use of an "X" indicates that the variable was tested in the particular experiment conducted by that committee and/or findings reported.
2. The placement of an "-" indicates that no information was reported.

FIGURE 8: EXPERIMENTS CONDUCTED AND RESULTS REPORTED

VI. MAJOR FINDINGS AND LESSONS LEARNED

A number of things were learned from the experiment. The individuals reporting the experimental results reported that at least some of the experimental interventions did accelerate the initial drafting process, particularly the five-day work week, the provision of secretarial assistance, and the clerical/duplicating support. Subsequently, an ANSI official interviewed indicated that several interest group members had convened and decided that in instances where an accelerated process was required and money was available to underwrite the costs, they had decided to implement the three interventions believed to be effective. On the other hand, in the normal course of events, the costs of the administrative supports were otherwise deemed too expensive and the money unavailable to sustain them.

These reported learnings are not, however, supported by the evidence generated in the experiments. Most of the lessons learned from the experiment are related to the experimental process rather than to the outcomes of the experiments conducted.

A. THE KNOWNS

An assessment of the experiments conducted indicates the following weaknesses inherent in the design and conduct of the experiments.

1. The requirement that ETIP fund the project with ANSI by transferring the funds through the NRC diminished the ETIP control over the design, development and implementation of the experiment. Problems also occurred in the reimbursement procedures as a result of the NRC's middleman status.[1]

2. There was substantial turnover of major personnel figures who were interested in the experiment as originally designed. This may have caused discontinuity in the project oversight and conceptualization, and in the project's political status and backing (e.g., the director of the AEC resigned; the original ETIP project monitor left)[2] This probably contributed to some of the changes which occurred in the project design and implementation, and also led to the problems in implementing the evaluation.

3. Planning and funding delays led to a permanent postponement of the evaluation planned to assess project outcomes and impacts.

4. The information provided by the existing contractors on key project variables and outcomes was incomplete. The data which were provided were either over-analyzed statistically in view of the same size and lack of experimental controls, or totally unavailable on the other hand.[3]

Even if the anticipated evaluation had been conducted, the results probably would have been disappointing. This is because:

1. The initial evaluation planning appeared to be short-sighted in terms of the scope of study necessary to answer questions about project impacts. For example, tracing whether the process accelerated NRC adoption required an evaluation spanning numerous years. Only one of the three standards had reached the NRC as of August, 1978. (See Appendix C for a discussion of what happened to the individual standards developed.) Major project assumptions could not be adequately tested within a one or even two-year evaluation period. In addition, there was insufficient up-front identification of the measures to be collected.

2. The initial design did not indicate how the proposed experiment fit into major research needs, or into the overall standards development process. In addition, the design did not include

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1. Garrity, pp. 14-16, 28-29.
2. _Ibid_., pp. 27-28.
3. _Ibid_., pp. 27, 31-38.

tasks to collect background data on the "normal" development process. Thus, there was no initial plan for collecting the type of objective comparative data needed to enable evaluators to assess whether the experiment accelerated the development of nuclear standards.

3. There was no suggestion of the need to collect background data to examine the accuracy of the experimental assumptions. Those who proposed and undertook the experiment relied on the assumptions outlined in Figure 4. That is, the project and evaluation designers presumed that by accelerating the establishment of standards, the NRC review of proposed nuclear plants would be accelerated, thereby accelerating the nuclear plant licensing and approval process. No background information was proposed to be (or was in fact) collected at the outset about the NRC licensing and plant approval process to see what role standards actually played--to check whether the assumptions about the role of standards in accelerating plant li- Thus, while it is entirely possible that the chain of assumpltions and expectations outlined in Figure 4 is correct, it is not apparent from the project documentation or interviews with interested parties that these assumptions were reviewed or questioned at the outset of the experiment. If they had been, the questions about the project's relevancy could have been better addressed both during the experiment and afterward.

B. THE UNKNOWNS

Because of the experimental design process, there remain many unknowns and uncertainties about the impacts of the experimental interventions. Little or no information was collected on such factors as:

- Average time for standard drafting and processing.
- The role of existing standards in the plant licensing process.
- Quality of the standards produced.
- Cost of introducing the individual innovations, compared with normal production costs.
- The details of the experiments conducted.

It would be difficult and costly to obtain information on these factors at this point in the project.

C. USEFULNESS OF FURTHER STUDY

Further study on the impacts of the experiments does not seem to be justified. The finding that providing secretarial and clerical support and longer working sessions accelerate the production of draft standards is not surprising, and there is sufficient information already available to justify the conclusion that the standards were drafted more quickly than was the usual case.

The issue which remains somewhat uncertain is the effect of accelerating the standard drafting process on the consensus process that follows in the standards development process. This question cannot be answered solely by further review of the experiment already completed, because the sample was too small. Additional research would be necessary, replicating the drafting stage experiment with a number of standards and tracing the standards through the remainder of the development process. Since only one of the standards in the current process proceeded beyond the initial stages of the review process, further follow-up of the initial standards alone would likely glean little additional information. Also, comparative information about the "normal" drafting process is needed to render the experimental data meaningful.

ETIP thus has several options relative to the conduct of further study on the voluntary standards process:

<u>Option 1</u>: Terminate the research at the conclusion of the present review.

Option 2: Fund a limited research effort to gather additional background information about the experiments conducted and their impacts (e.g., the costs of the individual innovations, the quality of the standards produced) as well as about the "normal" development process and time requirements in the nuclear standards area, with which to compare the experimental results.

Option 3: Fund a substantial research effort to identify the role of standards, if any, in accelerating nuclear plant licensing, using a research design and a contracting process which will address the difficulties experienced in the initial experiment and detailed in this and the earlier review. Assuming that standards are found to be a substantial factor in accelerating nuclear plant licensing, then ETIP could consider the usefulness of investigating how and whether the voluntary standards process can be successfully accelerated to develop those standards.

Option 4: Fund an evaluability assessment of the usefulness of conducting further study of the voluntary standards process and the impact of standards of nuclear plant licensing. This would involve collecting sufficient background information about the proposed research that the costs and likely results of the various research options could be assessed prior to commiting funds to any particular research design.

ASSESSMENT

Options 2 and 3 could be pursued if the resources are available. Option 2 would provide ETIP with additional impact information and allow the experimental results to be compared with the data on the "normal" standards development process. This would provide a better context for the experiments conducted. However, it is somewhat questionable whether the information derived would be worth the costs.

Option 3 would permit ETIP to address the larger question of the relevancy of attempts to accelerate the development of standards. In light of the recent 3-Mile Run nuclear incident, the question of the desirability of accelerating nuclear plant licensing has become particularly significant, if the acceleration implies safety trade-offs. An investigation of the role of standards in accelerating nuclear plant licensing while concurrently maintaining high safety standards should therefore be seriously considered. ETIP's selection of Option 3 would require a substantial research commitment over a number of years, however. This would probably extend well beyond the scope of the original project.

If further research in the standards area is contemplated, however, Option 4 is the most highly recommended. The conduct of an evaluability assessment would provide ETIP with guidance as to the areas where further research is desirable and likely to be fruitful, before significant resources are committed. Option 1 is the best selection at this particular stage of the ETIP program, however, if sufficient resources cannot be devoted to pursue any of the other options.

D. SUMMARY

Despite the design and administration difficulties with the experiment which was actually conducted, some useful information was gleaned. The drafting process is believed to have been accelerated. However, the goals of the experiment were not limited to the standards drafting stage.

To have learned whether the acceleration of the drafting stage accelerated the entire development process and NRC endorsement would have required beginning with many more standards, tracing them for several years to see what happened to them, and comparing their progress with the norm. To have learned whether

the availability of standards accelerated nuclear plant licensing would have required yet additional research. Considerably greater resources would have been required to conduct that additional research.

The current review was useful, however, in highlighting factors which need to be addressed by ETIP in the design of future regulatory experiments.

1. The process of funding projects through an outside agency can leave ETIP with less control over the design, development and implementation of its experimental projects. ETIP should explore ways to ensure that the integrity of ETIP experimental designs can be maintained. Policies and mechanisms for dealing with derailed projects should likewise be developed.

2. ETIP should assess proposed experiments at the project design stage to determine the probable validity of the underlying experimental assumptions and the feasibility of evaluating project impacts. This requires collecting background information about the regulatory process which is the subject of the experiment, the likelihood that the proposed changes can be implemented, and the feasibility of collecting the data necessary to evaluate the project's ultimate impacts. Had such a preassessment been conducted with the current project, many of the problems associated with the project design and data collection might have been foreseen and dealt with. Much of the misunderstanding and controversy over the value of the experiment undertaken might have thus been avoided.

APPENDIX A

INFORMATION SOURCES

APPENDIX A

INFORMATION SOURCES

PERSONS INTERVIEWED

National Bureau of Standards

Dr. Jim Liess, Director, Center for Radiation Research, National Measurement Laboratory and National Technical Advisory Group (also member, Nuclear Standards Management Board and National Technical Advisory Group)

Experimental Technology Incentives Program

Victor Berlin, Chief of Experimental Methods
Dan Fulmer, Chief of Regulatory Area
Stephen Garrity, Experimental Methods

American National Standards Institute

Mary Crehan Vaca, Secretary, Nuclear Standards Management Board
Mr. Richard Simpson, Washington representative, ANSI (ex-Deputy Assistant Secretary for Standards, NBS)

Nuclear Regulatory Commission

Mr. Leon Beratan, Chief Site Safety Standards Bureau, Office of Standards Developmnet
Dr. Carl Johnson, Director of Policy, Office of Standards Development
Mr. George Rivenbark, Branch Chief, Program Support Branch, Office of Standards Development

DOCUMENTATION

Anderson, H.J., "A Research Report, A Single Variable Experiment on Accelerating the Writing and Completing of National Concensus Standards." Final report on part of ETIP Project #47 submitted to the American National Standards Institute, Inc., New York, New York, February 27, 1976.

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APPENDIX B

ACCELERATING THE ESTABLISHMENT OF STANDARDS AND THEIR ADOPTION AS REGULATORY GUIDES BY THE ATOMIC ENERGY COMMISSION

APPENDIX B

PROJECT 47 PLAN

ACCELERATING THE ESTABLISHMENT OF STANDARDS AND THEIR ADOPTION AS REGULATORY GUIDES BY THE ATOMIC ENERGY COMMISSION

I

BACKGROUND

This is the first of a series of projects in which ETIP plans to examine the relationship between voluntary, or industry based standards and the regulatory process. This relationship is varied and complex: It ranges from the adoption by an agency of voluntary standards so that they then have the force of law, through the reference by an agency to a standard as an approved method of doing something, on to an independence from the regulatory process except as a standard may transgress national policy such as the antitrust laws. Each of the varying relationships has its own needs and concerns. It is therefore essential that ETIP experiment with these important relationships between voluntary standards and the regulatory processes in an attempt to optimize them.

This project addresses the need of the Atomic Energy Commission for the efficient and expeditious development of standards which may be used in the licensing process for nuclear reactors. In order for the country to timely secure the benefits of a developing technology and to stimulate investment in it by reducing the extraordinary cost of delay, the punctual development of hundreds of these standards is essential.

A. The Need for Standards. The advent of the recent energy crisis has underscored the need to begin using on a widescale something other than fossil fuels for the generation of electricity. While there is considerable research underway in an effort to discover commercially viable alternative fuels, currently by far the most promising is an expanded use of nuclear reactors.

But before a nuclear power plant may be used for generating electricity (or any other use), its design, construction, and operation must meet the stringent standards which have been established by the Atomic Energy Commission to protect the public health and welfare. Because the reactors are so complex and because the level of review must be so detailed, this licensing process is extremely time consuming. Currently it takes approximately ten years for a plant to begin operation after the decision was made to build it; in large part, this is due to the licensing process. This long lead time means that the country must meanwhile generate its power from fossil fuels and hence has to wait a long time to secure the benefits of a needed technology. Moreover, and perhaps worse, the long and expensive licensing process means that a utility which might be interested in building a nuclear plant must wait a long time before generating income on its investment, which in turn drastically raises the effective cost of the

plant and forces a utility to tie up capital for a long period. As a result, the President has declared that it is a national objective to reduce this process by several years.

One of the main reasons for the extraordinary length of time for the ultimate licensing is that the Commission must satisfy itself that all aspects of the plant -- from its location through its reactor design and all support equipment -- are safe and have a high degree of freedom from faults and errors; and, of course, the total system must have similar properties. If done on a plant-by-plant basis the individualized assessment of each part, sub-system and total system is necessarily time consuming. And it is also subject to human error since at each stage a new human judgment as to safety and reliability must be made.

In order to diminish the amount of time needed to review a proposed plant, as well as to diminish the chance of error, the Commission has encouraged, supported, and given priority consideration to activities leading to greater standardization of nuclear power plants in terms of their design, fabrication, construction, testing, and operation. Thus if a plant, or part of a plant, meets a standard, the Commission is able to approve that part without a de novo and detailed examination into all its facets -- from theoretical physics to industrial quality control.

Another benefit of standardization is that as the available technology advances the standards can be amended to incorporate it. Thus they not only diminish the amount of time consumed by the regulatory process and its chance for error, they also serve to advance the state of technology actually in use.

B. Regulations. The Commission has established a series of regulations which must be met before a plant can be licensed. Some of these regulations are general in that they state basic policy goals of the Commission or they are performance criteria which must be met. Others are quite specific and detail precisely what must be done.

C. Regulatory Guides. While the regulations must be complied with, often times there is still considerable leeway as to how that can be accomplished. For example, if a regulation requires that a part meet a certain performance level, there may be many ways of meeting that level and many ways of testing the part to demonstrate that it does. Thus, without more, many of the initial problems of an uncodified review process would remain: there would still be individualized review with its consumption of time and chance for error.

In order to provide a method of standardization without restricting the opportunity for developing new technologies which comply with the performance requirements, the staff of

the Commission has established a series of "regulatory guides". These guides inform applicants and licensees of ways acceptable to the Commission's regulatory staff of complying with the mandatory regulations. They implement the regulations and are not substitutes for them. They are not mandatory, and an applicant may meet the regulatory requirements in other ways if it can demonstrate the appropriate compliance. Thus the guides are approved methods of compliance.

D. How the Regulatory Guides are Established. The adoption of a regulatory guide begins with the development of a standard by either the AEC staff or by the industry and other experts -- suppliers, users, theoreticians, government personnel and others -- through the voluntary standards program. As it does in other areas, the American National Standards Institute (ANSI) acts as a clearinghouse which co-ordinates the development of standards within the private sector. The Nuclear Technical Advisory Board (NTAB) of ANSI is responsible for co-ordinating the development of nuclear standards, with the actual development of standards done by committees established by professional societies and standards groups.

In order to assure that the nuclear standards developed in the ANSI process will be suitable for use by the Commission in its regulatory program, the Directorate of Regulatory Standards co-ordinates standards, priorities, schedules and

standards writing activities with NTAB. The Director of Regulatory Standards is a member of NTAB and of its Executive Committee. More than 140 staff members of the Commission participate directly in standards writing groups of ANSI, and the Commission contributes more than $80,000 annually, in funds and services, to the ANSI efforts. The Director of Regulation has made a commitment that an ANSI-approved nuclear standard will be reviewed by his staff and action will be initiated to implement the standard within 90 days or ANSI will be informed as to why the particular standard cannot be adopted as either a regulation or regulatory guide.

In 1971 the Commission requested ANSI to greatly accelerate the development of standards pertaining to nuclear plants. ANSI responded by increasing its staff and expanding the scope of its activities to include an intensive effort in establishing priorities for needed standards, scheduling the development of those standards, and recruiting standards writers. Recently over 100 new working committees have been formed, management positions have been filled, and a large number of high priority projects have been scheduled.

The key elements in producing quality standards which may be used by the Commission are the efficiency and effectiveness of the standards writing groups. At present, the members of the individual standards wtiting groups are employees of utilities, architect-engineers, equipment manufacturers, and

of the Government, who have expertise and experience in the field in which the group is working. Their participation is purely voluntary and they are not separately paid for their standards-development work. For the most part the time spent on developing standards is only that which can be spared from their full-time duties with their employers or in their after-duty hours. Because of the need for highly qualified and experienced persons on working groups, the members are usually key staff members of their employers and consequently the demands on their time by their employers is heavy. Thus it may take a considerable number of weeks, months, or even years in order to secure enough of the time of these busy men to fully develop a standard.

The chairman of a committee has similar restrictions on his time, and yet his duties include the generation of background information which underlies a standard under development and the drafting and circulation of proposed standards. Since he too has so many demands on his time, this process may be considerably slower than it would be if the committee chairman could give the process more of his attention.

The Commission is vitally concerned with developing these standards as expeditiously as practicable so that the country can timely secure the full benefits of the technology of nuclear power. Hence it is interested in discovering ways

to accelerate the development of responsible standards for use in the regulatory process.

D. What is Proposed Here. In this project at least four changes will be made in the normal operation of several standard writing groups to determine if any or all of them have a significant effect on accelerating the establishment of responsible standards which are approved by ANSI and adopted by the Commission. The four changes will be:

- hiring a full-time working-group chairman
- providing consultant services for collection and correlation of basic data that is required by the group developing the standard
- clerical and technical editing assistance
- bringing the group together for up to two weeks to concentrate fully on the development of the standard.

II
PURPOSE

The purpose of this project is to determine whether any or all of the four changes in the method of developing nuclear standards is a desirable method for accelerating the establishment of responsible standards which are approved by ANSI and adopted by the Atomic Energy Commission.

III

ANTICIPATED RESULTS

It is anticipated that each of the four changes to be made in the usual method of developing nuclear standards will accelerate the development of those standards by enabling the committee to more directly focus its attention on reaching a consensus. In particular, the four changes are expected to have the following results:

A. Full-time Chairman. Since it is the chairman who is responsible for co-ordinating the committee -- from the development of information needed to reach consensus to the preparation and circulation of draft standards -- the demands on his time for administrative work are considerable. Yet it is he who must pass initial judgment on proposed standards and change relevant comment on a proposed standard into a suitable amendment to it; if information is needed he must know where to get it and, since there is rarely a budget for such things, he must usually have to know where he can generate it for free. Thus the chairman must necessarily be an expert in his field and must devote considerable time to the perfection of the standard on which his committee is working. By hiring a full-time chairman* these duties could be performed in a

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* All the duties of a committee chairman would probably only occupy half of the time of a suitable expert; thus "full-time chairman" means that the chairman will be paid to devote a specified portion of his professional time to the work of standards development.

much shorter period and with considerably more concentration, which in turn would mean the committee itself would be ready sooner to progress towards consensus and an acceptable standard.

<u>B. Consultant Services</u>. Many of the high-priority standards require the collection and correlation of considerable amounts of information before the committee can determine whether there is enough information on which to reach a consensus. Usually this information is gathered and correlated by the committee members themselves, and consequently it takes a considerable amount of time. If this information can be generated for the committee by a consultant group, then the time involved in preparing the background information can be significantly shortened. This too will reduce the amount of time required for reaching consensus by shortening the amount of time consumed in satisfying their need for information.

<u>C. Clerical and Editing Assistance</u>. As previously described, there is a considerable amount of administrative work in the development of a standard. Clerical and editing assistance will be provided the chairman in order to speed up the process of preparing initial and revised drafts of standards and the support documents which are distributed to the committee. This should facilitate the standard-development process by reducing the amount of administrative work per-

formed by the chairman and by providing professional help experienced in the process of codification.

D. Bringing the Committee Together. At present, most of the functioning of the committees is by mail or in isolated moments when its members are together for professional meetings. In this part of the project, a committee will be brought together for as much as two weeks to work exclusively on the development of their standard. The free exchange of ideas made available by face-to-face discussion, and without intervening duties, should mean that each member of the committee can give his full concentration to the development of the standard and any questions or disagreements which arise can be focused upon directly by the entire committee. This should serve to resolve many of the time consuming questions and disputes which naturally arise during the process.

Added together, it is anticipated that these four changes will mean that responsible standards in very difficult areas can be developed in a significantly shorter period than would otherwise be the case.

IV

APPROACH

The Atomic Energy Commission will be the lead agency in this project, but because of its regulatory obligations it will not perform its duties any differently than it currently does with respect to the development of standards in the

private sector. The overall management of the project will be by the Nuclear Technical Advisory Board of the American National Standards Institute, which occupies a special, quasi-official status with respect to the development of standards which are ultimately used by the Commission as part of its regulatory structure.

The Nuclear Technical Advisory Board will select three (or possibly four) standards which are of extremely high priority and which are difficult to develop because of a need for a considerable amount of information. The areas selected will also have standards developing committees already in existence and they would be able to be carefully monitored so that the results of this project can be reliably measured. The four areas are:

- site seismic design considerations
- effects of combined natural phenomena - design considerations (seismic, flooding, tornado, etc.)
- fuel quality assurance
- valve and pump qualification standards.

NTAB will hire, on a part-time basis, a program manager to be responsible to it for the management of this project. The program manager will be the chief administrative officer of the project, and will be responsible for hiring the respective chairmen, the clerical and editing assistance, and the

respective consultants; he will be responsible for scheduling and ensuring that the schedules are met; he will also keep account of how the three or four committees use their resources and the effect of this project on the development of the respective standards.

No specific program for the use of the four changes itemized has been determined. It is felt that rather than establishing a set matrix for their use before the committees begin actual operation, it would be best to allow the committees to draw upon these resources to enhance their ability to develop their respective standards. It will be the duty of the program manager to keep detailed accounts of the use of these resources and to ensure that they are used by the various committees in such a manner that the effect of each can be appropriately determined; that is, the three or four committees will not duplicate each other in their use of the four changes. For example, one (or more) of the committees might not have a full-time chairman but would extensively use consultants and editors; another might have a full-time chairman but use consultants sparingly because he would develop the information himself. If a committee feels some other related resource would greatly aid it in developing its standard, then the project manager may approve the use of the funds of this project for such other purpose upon the written consent of ETIP and the Director of Regulatory Standards of the AEC.

It is anticipated that the project will run for approximately one year, although the work of some of the committees may extend somewhat beyond then. The approximate cost is anticipated to be broken down as follows:

$20,000	- Program manager (part-time)
55,000	- 3 chairmen (each with technical expertise in his field; each hired on 1/4 - 1/2 time basis) plus clerical and editing assistance
25,000	- Consultant services; plus 1 two-week meeting
$100,000	

It is anticipated that the chairmen will be individuals who have the relevant technical expertise and who are currently employed on a full-time basis by a firm interested in the prompt licensing of nuclear power plants; the hope is that an employer will permit a potential chairman to be hired on a part-time basis for this standards development work because of its importance. Another source for such chairmen are individuals who have recently retired from such an active occupation.

V

EVALUATION

The final evaluation of this project is whether the approaches to standards development which are undertaken are a desirable method of accelerating the establishment of responsible standards which are adopted by the AEC and which hasten

the licensing of power-generating reactors. In large measure, this evaluation will be based on the subjective opinion of those who are familiar with the standards development process by comparing what occurred in this project with what they would have anticipated would have been the case under normal circumstances. Thus the evaluation will be based on the following questions:

- Have the schedules for the standard development (both the overall schedule already determined, and the particular schedule determined by the project manager for this project) been met?
- Are the standards which result from the project of high-quality, in that they are readily acceptable by the Commission and in the opinion of the Commission's staff they are comprehensive and as easy to use as is practicable.
- Did the project generate a more effective and efficient use of the working group members?
- Was the time from initiation to adoption by the Commission reduced sufficiently to offset the cost of the project?

If it is determined that aspects of this project have significantly reduced the amount of time necessary for the development and adoption of standards, an inquiry will be made as to how much the time needed to secure ultimate licensing

can be reduced by the adoption of a comprehensive code of regulations and regulatory guides. If that period can be significantly reduced by such a code, then an inquiry will be made as to why the private sector, which would profit financially from the reduction, has not undertaken similar efforts in the past. An inquiry will also examine what may be done to improve the existing system and to better use the resources of the private sector.

Another inquiry will be made as to the public benefits, such as improved public safety or reduced manpower needs, which stem from the adoption of such codes, and whether the Government should routinely sponsor similar efforts.

The evaluation will be conducted by a contractor hired for the purpose by ETIP.

APPENDIX C

DETAILED CHRONOLOGY

APPENDIX C

DETAILED CHRONOLOGY

Early 1973

1. ETIP issues a request for "Qualification and Interest" statement. ETIP placed a notice in the Commerce Business Daily which broadly described ETIP's mission and requested Q and I statements as well as suggestions for work in the regulatory area. This request was to be the first of a two-stage procurement.

Early 1973

2. ANSI response. The American National Standards Institute (ANSI) responded to the request. They suggested the idea that ETIP reimburse their committee members for travel expenses. According to Garrity, "the idea didn't impress people" at the time.

Early 1973

3. Second stage of procurement dropped. According to Garrity, the first phase served to bring ETIP in contact with some qualified firms. The second stage "died a natural death."

1973

4. Contact with Rogers. The discussions with ANSI led to contact with Lester Rogers, the Director of Regulatory Standards for AEC. He was interested in improving the voluntary standards at ANSI. From this time on, ETIP had continuing contact with Johnson who worked for Rodgers.

March 21, 1974

5. ETIP completes a project plan for the NRC experiment. The plan indicated that the NRC project was the first in a series of projects examining the relationship between voluntary standards and the regulatory process. The plan lacked a broad perspective and did not relate the "experiment" to overall standards development or to industry. The following four interventions were proposed: paying a full-time committee chairman, using consulting services for information gathering, clerical editing assistance, and more lengthy meetings.

According to the plan, the Nuclear Technical Advisory Board of ANSI would manage the project, select standards and hire a program manager. AEC would retain overall approval authority.

Under the plan, the Nuclear Technical Advisory Board (in ANSI) would manage the project. They were supposed to select standards and hire a program manager.

6. No Interagency Agreement. There was no interagency agreement because there was no actual transfer of funds. By congressional mandate, AEC could only receive funds appropriated by congress. As a result, ETIP held an account dedicated to AEC. ANSI would bill AEC and AEC would then bill the NBS account.

April 12, 1974

7. ETIP sends project plan to AEC.

May 23, 1974

8. The assistant secretary for science and technology approves the plan.

June 12, 1974

9. ETIP obligates $100,000 for AEC/ANSI use. According to the case study, ETIP lost effective control of the project at this time.

June 1974

10. ANSI activity not in conformance with several plan provisions. Instead of hiring a program manager to coordinate the intervention and conduct the experiment, ANSI decided to contract out the experiment, contrary to the plan. It is not known, who at ANSI/NRC made these decisions. According to Garrity's case study, "ANSI . . . reworded the language of the plan specifying the interventions to be used. These interventions became illustrative, leaving ANSI the option to suggest other interventions it felt important." (p. 16)

June 1974

11. ANSI issues a request for proposal for the experiment.

August 28, 1974

12. Battelle-Northwest submits a proposal to ANSI. The proposal said Battelle would look at different variables in three committees.

September 1974

13. Two committees meet. Two of the four committees to be involved in the experiment hold their first meeting.

October 15, 1974

14. Contract is signed with Battelle. The contract was funded for $80,000.

October 29, 1974

15. Harlan Anderson submits a proposal. Anderson, from Westinghouse-Hanford Corporation, submitted a proposal to study the effects of one variable in a single committee.

November 7, 1974

16. ANSI informs Anderson of proposal acceptance. The contract was funded at $5,000.

December 31, 1974

17. Rogers, Director of AEC's Office of Regulatory Standards, retires.

January 19, 1975

18. The AEC becomes the Nuclear Regulatory Commission by executive order.

March 25, 1975

19. Development of a project plan for the evaluation of the experiment. According to Garrity's case study, "The plan considered backgrounding of standards development process, a detailed review of the experiment, the post-experiment history of the drafts, the project costs and what recommendations could be made." One problem with the plan was the requirement that substantial process data be collected, even though the experiment was half over.

April 18, 1975

20. Plan approval. The assistant secretary for science and technology, Department of Commerce, approved the project plan for the evaluation of the experiment.

June 16, 1975

21. ETIP funds for the evaluation are obligated to NRC. The amount set aside for the evaluation was $15,000.

September, 1975

22. Berlin joins ETIP. Early in his tenure he became involved in the project, arguing for a wider focus on ANSI's standards development process.

September 1975

23. Battelle submits its final report dealing with the three-committee experiment.

September 1975

24. Harter leaves ETIP.

December 2, 1975

25. NRC asks ANSI to prepare a proposal for the evaluation.

January 1976

26. ANSI becomes dissatisfied with reimbursement procedure. ANSI billed NRC which in turn billed NBS. However, NRC held the bills until a large enough amount was accumulated. According to the case study, ANSI needed faster processing of bills and also wanted reimbursement of precontract costs.

Late January 1976

27. ANSI sends out requests for proposal for conduct of the evaluation. ETIP was unhappy with the RFP.

January 30, 1976

28. Three proposals submitted to ANSI. The bidders were Stafco, Rockwell International, and Nuclear Services Corporation. All three proposals were unacceptable to ETIP.

February 11, 1976

29. ANSI sent its own proposal to NRC to do the evaluation. (Thus, ANSI was in the unusual position of bidding to do a job and issuing RFPs to firms to do the same job.)

February 27, 1976

30. Anderson submits his final report to ANSI.

Spring 1976

31. NRC attempted to put through sole-source contracting with ANSI. The Garrity case study says, the attempt "was running into delays because NRC was uncertain that ANSI was uniquely qualified to conduct the evaluation." (43)

June 14, 1976

32. ANSI sent a second, revised proposal for evaluation to NRC. However, NRC failed to act on the second proposal either. A year passed since ETIP had obligated the evaluation contract funds.

July 21, 1976

33. NRC asks ETIP to take control of the evaluation. According to Garrity, Rivenbark and Johnson from NRC's Office of Standards Development, were simply not interested in the evaluation, partly because NRC was not directly involved in the experiment itself. Also, Victor Berlin wanted to expand the scope of the evaluation to include NRC processes. According to Garrity, "This may have turned them off." In his case study, Garrity describes NRC as reluctant to have any one study their processes. Finally, ANSI was annoyed at the rate of reimbursement and NRC was reluctant to continue its accounting function.

November 29, 1976

34. ETIP deobligates funds for the evaluation of the experiment.

APPENDIX D

A REVIEW OF THE NUCLEAR REGULATORY EXPERIMENT

APPENDIX D

A REVIEW OF THE NUCLEAR REGULATORY EXPERIMENT

Stephen Garrity

Experimental Methods
ETIP

January 17, 1977

TABLE OF CONTENTS

1.0 Introduction

The Experimental Technology Incentives Program (ETIP) conducted an experiment with the Nuclear Regulatory Commission (NRC) from 1974 to 1976.* The experiment consisted of two phases: one which involved changing experimentally some parts of the process used to develop nuclear regulatory standards, and another which was supposed to evaluate the effects of these changes. The purpose of this paper is to review the NRC experiement and discuss the implications for the conduct of future experiments.

Approach to the Review

The approach used in developing this paper was to review activities and documents generated over the life of project by the groups involved. The majority of the documents reviewed are included as references in this paper. The major events of the project are listed chronologically in the appendix.

When the majority of the project literature and information was examined, it was decided to divide the paper into several

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*It should be noted that during the time period of this experiment the Atomic Energy Commission (AEC) was abolished and the Nuclear Regulatory Commission was established. This paper will include both names, even though for purposes of the experiment the two organizations were essentially the same.

parts which could be reviewed and analysed independently of other parts. The resulting sections represent various time segments of the project, with some sections having more structured examinations than others. There are sections on ETIP and NRC background, initiation, design, implementation, analysis, and evaluation. A final section presents conclusions and recommendations for the NRC experiment and ETIP experiments in general.

2.0 Background

2.1 The ETIP Program

The Experimental Technology Incentives Program (ETIP) seeks to affect public policy and process to facilitate technological change in the private sector. ETIP's goal is the development of a set of policy guidelines on technological change and the body of knowledge necessary for their effective use. This goal is being pursued through the examination and experimentation with government policies or practices in regulatory, economic assistance, procurement, and research and development areas. ETIP works with government agencies and provides assistance and funding for the conduct of studies and experiments with policies.

The regulatory policy area at ETIP is interested in examing the relationship between government regulation and the rate or direction of technological change in the private sector. One focus is on the regulatory development process which often involves excessive time delays. This lag problem is exemplified in the nuclear regulatory arena where standards are used by the Nuclear Regulatory Commission in its liscensing process for power plants.

2.2 The Nuclear Regulatory Commission

The Nuclear Regulatory Commission (NRC) is an independent government agency concerned with the civilian uses of nuclear energy. Its purpose is to "assure that the civilian uses of nuclear materials and facilities are conducted in a manner consistent with the public health and safety, environmental quality, national security, and the antitrust laws" (Office of the Federal Register, 1976, p.588).

The Commission fulfills its purpose through the licensing and regulation of nuclear materials and facilities. The major program components of the commission are the Offices of Nuclear Reactor Regulation, Nuclear Material Safety and Safeguards, Nuclear Regulatory Research, Standards Development, and Inspection and Enforcement. Some examples of commission activities are the (Office of Federal Register, 1976, p. 588):

1. Licensing of nuclear power plant construction and operation.

2. Licensing the use, processing, and transport of nuclear materials,

3. Development and implementation of rules and regulations governing licensed nuclear activities,

4. Conduct of public hearings on radiological safety, environmental, and antitrust matters, and

5. The development of effective relationships with the states regarding the regulation of nuclear material.

The major focus of the commission is on the use of nuclear energy to generate electric power (Office of the Federal Register, 1976,p588). Before a nuclear plant can be used to generate electricity, NRC must approve the design, construction, and operation of the plant in accordance with the Commission's established set of regulations. This can be a lengthy review due to the complexity of power plants and the need to consider individual designs and subsystems. In 1974, it was estimated that it took approximately ten years from the decision to build a plant to the beginning of its operation, and a major part of this period was devoted to the approval process (ETIP, 1974, p.2).

One approach used by the Commission to reduce the time required is that of encouraging standardization in nuclear facilities. The Commission issues regulatory guides offering approved methods of compliance with the mandatory regulations (ETIP, 1974, pp. 4-5).

Regulatory guides are developed either by the Commission or by experts in industry, academia, or government through a voluntary standards program (ETIP, 1974, p.5). This program is coordinated within the American National Standards Institute (ANSI) by the Nuclear Technical Advisory Board (NTAB). The Board establishes and manages committees of experts for developing nuclear standards. These standards are submitted to NRC for adoption. In order to coordinate NTAB output with NRC needs and ensure suitability of standards, the director of the Office of Standards Development at NRC participates as a member of NTAB and its executive committee (ETIP, 1974, p.6).

2.3 Development of the Experiment

The new energy conscious climate of the early 1970's focused national attention on methods for producing electricity (ETIP, 1974, pp. 2-3). With nuclear reactors being one of the more attractive alternatives to fossil fuels, interest in building more nuclear plants increased. However, it was taking a long period of time to bring plants on-line, in part, due to the lengthy licensing process of AEC. In 1971 the Commission requested that ANSI accelerate their voluntary standards program to help reduce these time delays (ETIP 1974, p.6). ANSI increased its efforts, but even in 1973 it was still the Commission's view that more improvements in the

process were needed (Rodgers, 1973).

ETIP's involvement with this problem began in early 1973. ETIP had issued an announcement in the Commerce Business Daily presenting ETIP interests and requesting opinions from private firms (Harter, Note 1). This was the first stage of a two-step solicitation for developing some contracts with qualified firms (Van Wyk, Note 2). ANSI responded to this request by proposing an experiment with the voluntary standards process. In an attempt to accelerate the work of their standards committees, ANSI proposed to reimburse committee members for travel expenses to meetings. While initial ETIP interest was low, further discussion of the idea with two members of NTAB indicated that there might be more experimental potential than originally proposed (Harter, Note 1).

These initial discussions led to contact with another NTAB member, Lester Rodgers, the Director of Regulatory Standards for AEC. Rodgers was very interested in improving the voluntary standards development process at ANSI (Rodgers, 1973). He provided the contact ETIP needed to make the project relevant to a government policy maker and to fulfill the ETIP model of working through other government agencies.

Development of a formal plan for an experiment began in

early 1974 with discussions between AEC and ETIP. The focus remained voluntary standards committees of ANSI, even though AEC itself also had a part in the overall standards process.

These committees depended on volunteer experts from government, academia, and industry. They lacked sufficient support services to help construct, produce, and distribute drafts. Both ETIP and AEC were interested in learning if alteration of these conditions might help reduce the time needed to draft a standard.

3.0 The NRC Experiment

3.1 Initiation of the Experiment

The general approach in initiating an experiment from the ETIP perspective is to first make contact with another government agency and discuss the feasibility of doing an experiment. If the discussions indicate some potential for collaboration, work is started on a project plan and other related documents, which must be approved by both ETIP and the agency for a project to begin. In the NRC experiment, the project plan was developed primarily at ETIP and was used in the approval process in the Department of Commerce to justify a transfer of funds to AEC. AEC then used the plan to contract the experimental work to ANSI while AEC maintained overall approval in the project.

3.1.1 Planning

<u>Describing the Problem</u>

The project plan provided an overview of the voluntary standards process including the need for standards, their development and use, and how the various groups (ANSI, AEC and industry) were involved. The main problem focus was on the ANSI part of the process and how it might be accelerated

through alteration of conditions under which drafting committees worked. While the plan was sufficient for an overall perspective, several issues should be noted:

1. The relevant background and interests of the groups involved with the experiment were not all discussed in enough detail.

•For ETIP the plan indicated that work with NRC was first in a series of projects examining the relationship between voluntary standards and the regulatory process (ETIP, 1974, p.1). Documents available to this writer did not indicate an overall strategy involving a series of projects, and thus the ETIP objectives for the project, both in substantive and methodolgical areas, were unclear.

•The perspectives of industry were not discussed enough for one to understand the industry stake in the voluntary standards program or its acceleration. It was indicated that industry suffered a long delay to eventual plant operation, (ETIP, 1974, p.2). It is unclear how changes in the ANSI standards program, which provides input to NRC and involves industry, would have an impact on industry in the long run, particularly in terms of technological innovation, a key ETIP interest.

•The project plan discussed some of the standards development process at ANSI but avoided an overall perspective of ANSI functions and problems. Thus, while the focus was on important administrative problems of Committees, equally important technical issues in standards development were not discussed (Swisher, Note 3). Also, the other ANSI functions in the process, such as coordinating reviews of standards in the field, were not discussed.

•The standards process at NRC itself was only briefly discussed.

2. While it is unreasonable to expect that extensive discussions on each group would appear in the plan, the general indication from these shortcomings is a lack of overall perspective of the problem. There is no way to assess the overall importance of the process at ANSI, and potential subsequent impacts due to its acceleration, against the rest of the process at NRC and in industrial application. This would create problems later during implementation and evaluation phases of the experiment.

Proposing Some Changes

With the problem focus on the time delay and working conditions of committees at ANSI, an experiment in altering

some of the working conditions was proposed. The purpose of the project was "to determine whether any of all of the four changes in the methods of developing nuclear standards is a desirable method for accelerating the establishment of responsible standards which are approved by ANSI and adopted by the Atomic Energy Commission" (ETIP, 1974, p.8). The four changes suggested were paying for a full time committee chairman, utilization of consulting services for information gathering, clerical and editing assistance, and bringing the committee together for more lengthy meetings.

Approach to Conducting the Experiment

The experiment involved several agencies and some steps were proposed in how the project was to be conducted. These were as follows:

1. ETIP, after receiving approval of the project plan within the Department of Commerce, would transfer funds to AEC[1].

2. AEC would contract with ANSI, via a sole source procedure, to conduct the experiment for a period of one year.

[1]It should be noted that AEC was only allowed to use appropriated funds. Thus, it could not accept funds from ETIP. The actual arrangement was to establish an account at NBS dedicated to the AEC project. AEC would bill this account. (Penn, Note 7).

AEC would still retain overall approval authority.

3. The Nuclear Technical Advisory Board (NTAB) of ANSI would be responsible for the overall management of the project. This would include selecting the standards to be used in the experiment and hiring a program manager to run the project.

4. The program manager would hire chairmen for the test committees, hire and coordinate support services, and collect data.

5. The individual committees to participate in the experiment would have the options to select interventions as needed in their particular situation, even to the extent of choosing interventions not in the project plan. The program manager would in all cases be responsible for approving interventions and assuring that their impacts could be assessed later.

The most notable factor about these arrangements is that the organizational/managerial distance between ETIP and the actual experiment was so large. There are several factors which facilitated or hindered this structure.

1. The commitment of the Director of Regulatory Standards at AEC was a powerful and useful factor (even though project

monitoring was later passed to someone else). Specifically:

•The Director (Lester Rodgers at the time of project initiation) was a champion of reforming the standards process, the central issue of the experiment. This was clear from formal contacts between ETIP and AEC (Lewis, Note 4; Harter, Note 5) and his testimony to Congress (Rodgers, 1973).

•The Director was a member of the Nuclear Technical Advisory Board (NTAB) of ANSI, the group responsible for coordinating nuclear standards work at ANSI. He was also a member of the executive board of NTAB and later took part in the ad-hoc committee for the experiment established from ANSI/NTAB membership.

•The Office of Regulatory Standards at AEC was the immediate user of ANSI nuclear standards work of the type to be used in the experiment.

2. ETIP is interested in conducting its work through other government agencies. Contracting the experiment through AEC (rather than directly with ANSI) assured that the Commission had a direct stake in the experiment. However, the control of project funds by AEC also presented some problems for ANSI (see section on implementation).

3. Essentially, ETIP did not have control over the conduct of the experiment, as this rested with NTAB. This would be a problem later in contracting (see next section) and experimental methodology (see section on implementation):

•The project plan left a certain flexibility to the program manager in controlling experimental changes in the committees.

•The project contracted at ANSI was already different from the one initiated at ETIP.

4. During the course of the entire experiment, personnel in the chain changed (see sections on implementation and evaluation). Also, AEC became the Nuclear Regulatory Commission (NRC) in 1975.

3.1.2 Contracting

In June, 1974, the funds for the experiment were transferred to AEC, which then contracted to ANSI on a cost-reimbursable basis. At this point effective control from ETIP was no longer possible. ANSI went out for bids from consulting firms to conduct the experiment, contrary to the plan of hiring a program manager who would coordinate ANSI committees and in-

terventions. ANSI also reworded the language of the plan specifying the interventions to be used. These interventions became illustrative, leaving ANSI the option to suggest other interventions it felt important (Harter, Note 6). These changes were not expected by ETIP (Harter, Note 6).

The result of these arrangements was the hiring of Battelle-Northwest to conduct the experiment. Later a separate agreement was made with Harlan J. Anderson from Westinghouse-Hanford Corporation to conduct a similar experiment with one of his committees, using only one of the proposed interventions. The proposal by Battelle was accepted as the basis for their work.

3.2 Experimental Design

Some amount of design for the experiment was available before the experiment began. Battelle discussed independent variables, the variation of independent variables over the test committees, and the dependent variables. On the other hand, Anderson only proposed the one change variable and did not discuss others. This section of the paper will focus on the experimental design utilized by Battelle, since theirs was more complete and they were the primary contractor. The known characteristics of the Anderson experiment will be identified as the Battelle design is presented.

3.2.1 The Approach Used and Variables

The basic approach of this experiment was exploratory. It was hypotesized that certain factors in the drafting process of the voluntary standards groups, such as clerical support and prior assignment of responsibilities, would have a significant relationship to the speed at which a draft of a standard could be produced. Other considerations were the cost of alternative processes in the group effort and the quality of output. It was unclear what impact new committee procedures would have on these two variables.

<u>Independent Variables</u>

Battelle considered factors in the process which were most likely to be contributing to the slow development of standards (Battelle, 1975, p.5). The independent variables chosen for maniputlation in the experiment and the difference over normal procedure were as follows (Battelle, 1975, pp. 6-7):

1. Working meeting. A five day working meeting held at Battelle. This was different from the usual practice of having several periodic meetings and communications (ETIP, 1974, p.11).

2. Working draft or outline. A working draft of some form would be distributed before the working meeting. While

this appears to be the usual procedure, the differences here were whether it was a draft or outline.

3. Executive secretary. A support person responsible for assuring the availability of needed services during meetings and revising drafts according to group member comments. This constituted new services for meetings and a reduction in the chairman's workload in communicating committee work. This was the main intervention made in the Anderson experiment. It appears that the person in Anderson's experiment also performed clerical and duplicating functions, a separate intervention for Battelle.

4. Clerical and duplicating personnel. Support persons responsible for preparing drafts and distributing materials to the committee. This reduced some of the work normally done by the chairman.

5. Payment of the chairman. Payment of the chairman for work performed on the standard. This was different from the usual practice of the chairman being supported through his employer.

6. Travel and living expenses. Payment to committee members for travel and living experses incurred while par-

ticipating in meetings on standards. This was different from the usual practice of support from the employers of committee members.

7. Preliminary meeting. Meeting held before the five-day sessions in order to begin preliminary discussion and assign responsibilities. This intervention appears to be due more to recognition of group meetings before the experiment began.

8. Committee membership. Committee sizes were limited to about ten people. While this also appears to be a function of group conditions before the experiment, it was probably a reasonable idea to keep groups the same size so that theorectically the workload would be the same for all of the committee members.

Battelle used these factors in variation on three committees:

1. INMM - 11 for ANSI standard N15.28, Criteria and Standards for the Certification of Nuclear Materials Managers.

2. ANS - 2.12 for ANSI Standard N635, Guidelines for Combining Natural Phenomena and Man-made Hazards at Power

Reactor Sites, and,

3. ANS - 18.6 for ANSI Standard N231, Discharge of Thermal Effluents Into Surface Water.

Anderson used the one intervention on the ASTM C-26 Committee on Fuel, Control, and Moderator Materials for Nuclear Reactor Applications.

The conditions were varied over the groups as follows (Battelle, 1975, p.8):

TABLE I. Elements of the Experiments

	Standard N635	Standard N15.28	Standard N231	ASTM C-26
Working Meeting	X	X	X	
Outline of Standard Prepared and Distributed		X		
Draft of Standard Prepared and Distributed				
By Chairman			X	
By Executive Secretary	X			
Executive Secretary Provided	X	X	X	X
Clerical and Duplication Assistance Provided	X	X	X	X
Chairman Paid		X	X	
Travel and Living Expenses Paid		X	X	
Preliminary Meeting/s	X	X		
Committee Size Limited	X	X	X	

It should be noted that independent variables were not assigned to the committees in any apparent procedure other than by recognizing already existing conditions or needs (ETIP, 1974, p.13). It was to be the duty of the project manager to assure that they were "used by the various committees in such a manner that the effect of each can be appropriately determined" (ETIP, 1974 , p.13).

Also, some of the variables as listed above were later ignored in the data analysis. For example, the specification of draft or outline was reduced to working draft, and a preliminary meeting was reduced to assignment of responsibilities prior to the five-day meeting.

Dependent Variables

While the speed of the drafting process was the major variable of interest in this experiment, there were two other outcome variables which also needed to be examined. These were the quality of the draft standard and the cost to produce it. Because of the many groups involved in the standards process (e.g., NTAB, ANSI, NRC, the nuclear power community, etc.), these variables were further defined by reference to the appropriate group. Thus the independent variables considered by Battelle in their proposal were (Battelle, 1974, pp. 6-8):

1. Time. The time required by the committee to produce a draft for submission to NTAB.

2. Quality of the draft standard. The quality of the draft standard based on the number and significance of the comments received from the field on the first draft distributed for comment by NTAB.

3. Cost of preparing the standard. The cost of preparation (e.g., salaries, travel, clerical support, publication, etc.) for submission to NTAB.

3.2.2 Analysis of the Design

In order to evaluate the experimental design chosen by Battelle, some criteria were needed.* One scheme which appeared to be appropriate was the use of a decision process developed by Anderson (1972). In this process experimental designs are chosen on the basis of six questions about what information is needed from the experiment and the conditions involved. This diagram and supporting papers appear in the appendix.

*Most of the following comments also apply to the experiment conducted by Anderson for ASTM C-26.

The six questions are listed below and the answers, as determined by the writer, follow:

1. Which type of evaluation is needed?

Although the approach to this experience was exploratory, the independent and dependent variables were known and some of the expected outcomes were discussed before the experiment. The evaluation needed to assess the effects of the independent variables on the outcome variables: time, cost and quality.

2. Can control groups be used?

Control groups were used for the experiment in that three standards each requiring a different committee were chosen and the independent variables varied in the treatments. However, the indpendent variables were numerous and not assigned in any logical order for control purposes. As it turned out, each of the three Battelle groups had almost all of the possible changes. This problem was identified to Battelle early in the experiment by NTAB members, apparently with no effect. (Nuclear Technical Advisory Board, 1974, p.7).

Another weakness with the design was that there were no control

groups operating under the usual circumstances. This need was considered in the ETIP project plan (ETIP, 1974, p.15). However, further contact with the committee system at ANSI indicated the difficulty of comparing different people, technology issues, and priorities (in terms of need by NRC) (Harter, Note 1).

3. Is random assignment possible?

Random assignment of groups to the experimental conditions or to the usual arrangements did not occur. It was probably not feasible given that NTAB was to select standards needing priority attention, having established drafting committee chairman but no previous meetings, covering different fields, and having similar levels of difficulty (ETIP, 1974, p.12, Nuclear Technical Advisory Board, 1974, p.6).

Random assignment of committees to the different treatment conditions was not performed either because it was felt by ETIP and NASI that the committees should have the flexibility to choose conditions based on need (ETIP, 1974, p.13, Note 6).

4. Are repeated measurements possible?

Repeated measurements would have provided some before

and after treatment comparisons of committee performance. However, the committees were typically formed to draft one specific standard. This prevented any comparisons between committee performance on two different standards, especially with main interest being on variables based on committee output only (time, cost, and quality).

Given the answers to these questions, and the flow of the decision process of Anderson's (1972, p.50), the resulting conclusion is that design 3 from Campbell and Stanley (1966) would have been the design appropriate to the conditions of the experiment. This design uses one set of observations made on two comparable but not randomized groups:

X 0_1	X = treatment (application of the independent variables)
0_2	0 = observation of the dependent variables

$\xrightarrow{\hspace{2cm}}$

TIME

The design used by Battelle was weak on two points then:

1. They did not utilize any comparison groups operating under the normal working committee conditions. This would

make it difficult to validity claim improvements over normal conditions.

2. They did not vary the treatment or reduce the number of treatment options to the point where the three experiment groups could act as controls to each other. Thus, the independent effects of the different treatment options would be unidentifiable.

Some other problems arising due to these conditions were:

1. Selection.

Since randomized assignment of groups was not possible and treatments were used according to need, it would be difficult to identify varying committee experiences as being the result of the varying treatment conditions or the self-selection of these conditions by the committees.

2. Interaction of selection and the treatment.
Without comparisons to groups operating under the usual arrangements, it would be difficult to claim any generalizability to the results. Experimental results could be partly or solely a function of the types of committees chosen for the experiment.

3.3 Implementation of the Experiment

Battelle started work on the contract in October, 1974, and submitted their report one year later in September 1975. A separate agreement was made with Harlan J. Anderson of Westinghouse-Hanford Corporation in November 1974, and a final report received in February 1976. Since all control of the experiment was essentially at ANSI, there is little to discuss about the implementation from the ETIP perspective*. The implementation by ANSI is covered in other sections on planning and analysis.

There were, however, several interesting events that occurred during the contract period which should be noted. These serve to illustrate the problems with the contractual/organizational setup of the experiment:

•An ad hoc committee was established from ANSI-NTAB members to oversee the experiment. No ETIP representative was asked to participate until January 1975, at which time one person acting as an ex officio member was requested. This delay meant that ETIP had no direct input to the proposal-contract award decisions.

•Lester Rodgers, the Director of the Regulatory Standards Office at AEC, retired at the end of 1974. Rodgers was a

*This lack of control by ETIP later increased ETIP's interest in conducting a more well designed evaluation and re-establishing some control (Harter, Note 1).

champion of standards refroms and helped immensely in getting the experiment initiated. However, he did not participate in the day-to-day monitoring during the experiment. There are mixed feelings at ETIP whether this had an impact or not. For example, the main contact at the Regulatory Standards Office remained the same, and the new director had similar reform ideas to Rodgers' (Minogue, 1974a, 1974b). On the other hand, negotiations with NRC were not as smooth for the evaluation contract later, and NRC lost interest in having contracting responsibility for the evaluation. (See section on evaluation).

•Also, in January 1975, an executive order from the White House (based on the Energy Reorganization Act of 1974) was issued establishing the Nuclear Regulatory Commission (NRC) from parts of the Atomic Energy Commission (AEC). It is felt at ETIP that this changeover had litte impact on the experiment, since the same people remained on the project and the new Office of Standards Development was essentially the same as the previous Office of Regulatory Standards.

•By January 1975, three months after the beginning of the Battelle contract, problems with mechanics of the contract-agreement with ETIP, NRC, and ANSI were starting to arise. NRC by charter was not allowed to use any money except that appropriated by Congress (Penn, Note 7). This necessitated

an arrangement where ANSI had to bill NRC who, in turn, billed the NBS account. For ANSI, this procedure was different from their usual one of operating with grants (Van Wyk, Note 8). ANSI needed faster processing of bills and also wanted reimbursement of precontract costs (possibly arising from misunderstanding the meaning of a cost-reimburseable contract). NRC held bills until a large enough amount had accumulated.

3.4 Analysis of Outcomes

Two final reports were issued for this experiment, one by Battelle (Wittenbrock, 1975) for three test committees, and one by Anderson (1976) for one test committee. These reports are completely different and will be discussed in separate sections here.

3.4.1 The Battelle Report

Battelle proposed to analyze the experiment on the basis of time for preparation, quality of standards as determined by comments from relevant groups, and cost (Battelle, 1974, p.2). At the same time they indicated that the limitations of the project, and the large number of variables involved would provide little more than qualitative results (Battelle, 1974, p.3). They proposed to issue a questionnaire to the test

committee members for their evalution of the experimental approaches. Also a "check sheet" would be used to summarize the effectiveness of the three different treatment approaches (Battelle, 1974, p.8).

However, Battelle did not present in their final report most of what they discussed in their proposal. Again, arguments about the lack of quantitative measures, limited time, limited data, and many variables were discussed to justify a different approach to the analysis of the experiment (Wittenbrock, 1975, p.13). The final evaluation consisted of ratings from group members on the effectiveness of the innovations, observations by the Battelle project manager, and costs for the five-day working meetings. Thus, it should be noted that the three dependent variables were either not examined or only superficially so. Specifically:

1. Time to prepare the draft.

Time for preparation originally was defined in terms of the period up until submission of the draft to NTAB. Although, theoretically, this time length was available to Battelle as they were involved up to these draft submissions, no discussion of time was presented.

2. Quality of the draft.

Originally, draft quality was defined in terms of the number and significance of the comments received from the field on the draft submitted to NTAB (Battelle, 1974, p.6). Quality in these terms was not discussed in the final report.

3. Cost of preparing the draft.

Originally, cost estimates were to include all expenses of the standard drafting process. The costs discussed in the final report only include the costs of the executive secretary and salaries of the chairman (Wittenbrock, 1975, p.18). Travel and living expenses were not presented. The expenses of other committee meetings besides the ones at Battelle were also not included. All of the committees held meetings other than the five day session at Battelle.

Finally, the evaluation "check sheet" which was to act as a summary of the effectiveness of the three different approaches was not included.

<u>Ratings by Committee Members</u>

Questionnaires were distributed to committee members at or near the completion of the working session at Battelle. It

was felt by Battelle that because committee members had no long term commitment to the committee, their feedback would be relatively unbiased. While this shouldn't be disputed, the weakness was that their comments received the most attention in the report.

The questionnaires had 16 items which were identical for all test committees, except for tense in order to account for treatment variations. All members were asked to rate items as experienced or as they would have experienced them. This was a fairly weak approach given the weight placed on the results and the analysis techniques used.

The 16 items obtained ratings via Likert scales for the following issues (Wittenbrock, 1975, p.14):

1. The usefulness of each of the specific innovations instituted in this project;

2. The extent to which the composition of the committee was appropriate for the task;

3. The skills of the chairman;

4. The difficulty of the standard in question.

(e.g., scope); and

5. The overall performance of the committee.

It should be noted that only seven innovations were considered in these questionnaires, where eight had originally been defined (Wittenbrock, 1975, pp.6-7). Committee membership, while presented as an innovation, was dropped. Also, there was some modification of innovation definitions. For example, preliminary meeting was changed to mean prior assignment of responsibilities, leaving out prior organization and discussion as originally specified.

The first step of item analysis was to present the average rating for each innovation. The means for each group and the groups combined were high (favorable), except for prior assignment of responsibility, which had a more unfavorable rating. Battelle neglected to present standard deviations and ranges on these ratings, common and necessary indicators. There was no way to gauge the level of agreement within the groups. Also, they presented a mean of all of the individual innovation means, a meaningless indicator.

Next, these means were subjected to an analysis of variance to indicate agreement across groups. Three of the innovations

had group mean ratings which were statistically different significantly from each other. While the mean ratings would seem to support these results, it would have been useful to see significance levels. Battelle did not indicate what it considered significant. Also, Battelle made no effort to discuss why these differences existed.

The report then discussed another eight variables, basically parameters, which reflected the working characteristics of the committees, such as adequacy of committee representation and availability of data needed for writing the standard. Again, as with the innovation ratings, means are presented for for each group and overall. There are no standard deviations and ranges. The analysis of variance using these means did not provide any significant differences, but the actual results are not presented. Overall performance, the last variable, is handled in the same way as these also.

The next analysis discussed were regressions of the innovative and committee characteristic variables on overall performance. First, the innovative ratings were regressed on overall performance, then the committee characteristic ratings, and then both of these sets were regressed on overall performance. The prior assignment of responsibility had the only statistically significant relationship with overall performance. The inter-

pretation was that prior assignment was a "good" predictor of the group performance rating--the more favorable the rating towards prior assignment, the more favorable the rating of overall performance. It would have been interesting to examine this result in light of the previous indications that prior assignment was, on the average, the lowest rated innovation.

There are several problems common to all of these regressions. These are:

1. Small sample size, too many variables.

The three groups had sizes of 6, 7, and 10, or 23 total. While these are in general small sizes on which to base conclusions, this weakness is even more critical in the regression models used, where the number of variables in the analysis approaches the number of individual cases (Weiss, Note 9; Draper and Smith, 1966, pp. 62-63). For example, a perfect fit for a regression line can be made when there are two data points and one independent variable. Thus, n-1 variables, where n is the total number of cases, can specify a perfect fit. In the Battelle regressions, the three analyses are 7 variables and 23 cases, 8 variables and 23 cases, and 15 variables and 23 cases.

The R^2 factor in regression, a measure of the proportion of variation in data explained by a regression line, is

affected by this small sample problem. Since the impact is to inflate R^2, one is even less confident that Battelle really found anything significant.

2. Lack of specific regression information.

Many of the indicators normally presented with regression analyses are not presented in the report. Most importantly, analysis is presented for the innovation variables only. This included statistical significance levels for each innovation and the respective increases in R^2 as they were entered in the model. The report does not include any discussion of the regression constants A (intercept) or B (slope), which indicates the relative importance of each independent variable. These are normally tested to see if they are significantly different from zero. Also, the standard errors of the B constants were not included, providing no indication of the variability of the estimate.

3. No overall regression test.

A standard test of any regression line is the overall F test of whether R (from R^2) equals zero, or equivalently, whether all B weights are equal to zero. This test is not discussed. The "F to enter" statistic presented is not explained.

The combined effect of all of these problems in presentation and analysis is a decrease in confidence with the results. The two major findings based on these analyses are:

1. That most innovations tended to have positive effects, but several of them, such as payment of chairmen and living expenses, did not, and

2. That prior assignment of responsibilities seemed to be related to overall performance.

These have little support. A more rigorous approach in the application of changes and comparison to other committees is needed.

Observations

Observations of the three committees were made by the project manager at Battelle and apply mostly to the five day workshop period at Battelle. They support the favorable ratings given by committee members, but do not add a lot of weight to the results.

Summary

The basic conclusions to be drawn from the Battelle analysis

are that:

1. The analysis did not fulfill the proposed effort, and

2. While the experiment met some of the needs for exploratory information, no resolution was possible on the effects of the individual innovations.

3.4.2 The Anderson Report

The analysis of the ASTM C-26 committee performance was done independently of the Battelle report and submitted several months later (Anderson, 1976). Only one of the innovations was utilized, that of providing a knowledgeable executive secretary. This basic result claimed was that the provision of a secretary sped up the committee activities.

For the dependent variables used by Battelle results were:

1. Time.

Two standards were produced within one year instead of the usual two to three. (Anderson, 1976, p.3). Some examples were provided to show this, but these were not organized well enough in proving the point.

2. Cost.

The cost of the executive secretary was presented in detail. However, the salary for the secretary was not included since it was reasoned that under the ideal system, this salary would be "donated" by the companies or organizations supporting the committee members (Anderson, 1976, p.1).

3. Quality.

There was no definitive discussion of quality other than the aforementioned reference to appendix reports. To the unfamiliar observer, the evidence provided was unclear and not persuasive. On the other hand, the C-26 committee appeared to be enthusiastic about the results of using the executive secretary, implying satisfaction with the product (Anderson, 1976, pp. 3-4).

While the experiment intended with this committee was simpler than that of Battelle, it did not offer a level of comparability to Battelle, whereby commonalities could be assessed. The parameters briefly considered by Battelle do not appear at all in discussions by Anderson. The overall performance of C-26 is not discernable from the report.

3.5 Evaluation of the Experiment

An evaluation of the NRC experiment was first considered in the plan initiating the project (ETIP, 1974, pp. 14-16). It was proposed that ETIP hire a separate contractor for this purpose. The content of an evaluation was only briefly considered. Further delineation of the evaluation needs at this stage might have evolved into an "evaluability assessment", possibly guiding the design enough to avoid some of the problems encountered later.

3.5.1 Evaluation Project Plan

In the original project plan several evaluation issues were discussed. These included the timeliness of the process attempted, the quality of the drafts in the opinion of AEC, the efficient and effective use of committee members, and the comparison of acceleration accomplished versus costs. Considering the lack of background (at the time of the plan) on the standards process from ANSI through NRC, it is unclear whether these questions could have been answered in a reasonable amount of time. For example, the experiment essentially ended at the draft review process in ANSI, but the evaluation was to look at impacts in NRC.

During the experiment, it became increasingly clear that

the evaluation would have to be more encompassing that the above considerations. This arose because ETIP and ANSI personnel felt that the design by Battelle was leaving many factors unconsidered (Harter, Note 1). Also, ETIP had requested the Technical Analysis Division (TAD) of NBS to review the experiment and propose methods for measuring variables (Harter, Note 1). TAD commented that the intervention impacts were already obvious, that the design was poor and left variables such as group dynamics or technical problems unconsidered, and that there were too many variables for effective control (Swisher, Note 3; Harter, Note 10).

The outcome of these events was a more encompassing project plan for evaluation that was adopted by the Department of Commerce in April, 1975 (midway through the experiment). The plan considered backgrounding of the standards development process, a detailed review of the experiment, the post-experiment history of the drafts, the project costs, and what recommendations could be made (ETIP, 1975). The plan still lacked any emphasis on comparing the process and outcomes of the experiment with other similar variables in the normal procedure used at ANSI. Another problem with the plan was that it concentrated heavily on process variables. With the experiment half over already, it could not be expected that the perishable process data would be obtainable.

3.5.2 Contracting the Evaluation

With the evaluation depending on capturing the process experience of the committees, the necessity of contracting the work as soon as possible was obvious. However, the plan was seriously delayed and timely access to the participants and results of the experiment lost.

The basic organizational arrangement for the evaluation was to have been the same as with the experiment. Funds were transferred to NRC in June, 1975, but it wasn't until December 1975, three months after Battelle issued its final report, that NRC sent a letter to ANSI to prepare a proposal for evaluation. This work was designated by NRC as an extension of the experiment contract.

ANSI was to have responded by the end of 1975, but they took until February, 1976. During this time ANSI sent an RFP out for the evaluation contract and received three responses (Stafco, 1976, Rockwell International, 1976, Nuclear Services Corp., 1976). Also, the Director of Nuclear Programs at ANSI, who had been the main contact and coordinator for the experiment, left ANSI.

Before NRC received the ANSI response in February, ETIP contacted NRC and expressed displeasure with the process occurring (Berlin, Note 11). A month later, in March, there

was still no contract with ANSI. Also, several new events began to reorient the project.

•The new coordinator at ANSI for the experiment indicated that the process studied in the project was a small part of the entire standards process. He wished to explore the other parts and develop new ideas during the evaluation project.

•ETIP discussed the evaluation mostly with ANSI personnel, leaving NRC unaware of the changes being considered.

•ETIP began to push for comparing the tested committees to others operating under normal procedures. ETIP also pushed for a system analysis of the entire standards process to gain some perspective on the experiment.

•NRC attempted to put through a sole-source justification for contracting with ANSI. This was running into delays because NRC was uncertain that ANSI was uniquely capable to conduct the evaluation.*

*This was a reasonable concern given that ANSI was not uniquely qualified to do evaluation. Also, with more and more emphasis being placed on follow-up work in the standards process, ANSI would potentially be investigating the process at NRC. This would not have been an appropriate arrangement, especially considering NRC's reluctance to have anyone study their processes.

The outcome of these events was that ANSI issued a new proposal to NRC in June, 1976, but NRC could still not contract the evaluation to them.

At a meeting in July, 1976, NRC expressed the desire to remove themselves from contracting responsibility. While they were still interested in evaluation, they felt that ETIP could more appropriately manage it (Garrity, Note 12). The situation was also further complicated by the fact that the original contract between NRC and ANSI expired.

ETIP eventually agreed to a return of the funds for evaluation from NRC. The evaluation project was deobligated in November 1976, and the original experiment was deobligated in December 1976.

4.0 Conclusions and Recommendations

4.1 The NRC Experiment

The results of the experiment are fairly inconclusive. While the work of the selected committees may have been accelerated by the various interventions, it is unclear how the improvements compare to normal circumstances, and what the overall impacts have been on the drafting process at ANSI. The analyses presented are insufficient and at times methodologically weak for determining the individual impacts of the different changes made. If any conclusion can be made about the results, it is that it appears reasonable to accelerate the committee work by providing extensive support services in combination with prolonged meetings. What importance this has to other committees, other problems in drafting standards, other parts of the process, or industrial technology, is unknown.

The option still exists at this time to contract some analysis of the experiment in the evaluation phase of the project. Clearly the process data so important to this experiment is no longer obtainable. However, the resulting draft standards probably exist somewhere in the standards process and these may be interesting to examine. For example, the

history of each draft as it went through further review may be able to provide some evidence of the quality of the draft, one of the original outcome variables. The history may also show the relative importance of the acceleration of committee work to the later review processes of ANSI and NRC.

If any work is to be done, some effort should be included on specifying what constitutes the standards process. This would at least add some perspective to the experiment and could also point out other areas where further work could be done.

4.2 ETIP Experiments

It seems clear from this experiment that the backgrounding and contracting phases of a project are two of the more important considerations. While the hindsight review of these factors easily demonstrates their weakness, it does need to be realized that items overlooked at these initial stages can have impacts on later parts of the experiment that can not be so easily controlled or adjusted. For example, the apparent lack of perspective of the ANSI functions in the overall standards process left some uncertainty as to the importance of the experiment. Several groups expressed this point during the project and, in fact, the lack of importance became one of the lasting conclusions about this work.

What is needed in backgrounding is the careful and comprehensive examination of groups having a stake (either directly or indirectly) in the experiment. This includes defining the problem (or lack of) as each group views it and identifying what they might get out of the experiment. This is especially important where cooperation of a group is needed. Specification of ETIP contributions and utility in the project should also receive full attention.

Of equal importance with these analyses is the arrangements made between the groups to accomplish their objectives. The most obvious problem of the NRC experience was the organizational distance between ETIP and the experiment. The lack of control for ETIP in this arrangement resulted in some serious methodological problems in the experiment of large importance to ETIP. The arrangement was also not suitable for the two phases of the project. While ANSI control was most likely appropriate for management of the interventions, it was less relevant to an evaluation of the changes. This was especially true from the viewpoint of NRC since the ANSI work would have involved examining their processes.

The use of two phases, one for the interventions and one for the evaluation, also needs some discussion. First, it is

useful to have a follow-on strategy for evaluation, as this project did to some extent. However, this should be carried even further to the point of assessing the evaluability of any changes before they are made. An "evaluability assessment" would serve to further tie the interventions and evaluations to each other. This need was clearly demonstrated in this case because of the major emphasis on process variables. Evaluation at the later point could not compensate for the original design deficiencies.

Furthermore, it would seem useful that ETIP consider an experiment as consisting of interventions and evaluation rather than separating the two into several independent phases. Even a cursory glance at the Battelle work demonstrates the need for this, even if one only considers that the difference between Battelle's "experimental analyses" and the proposed second phase evaluation was small. In principle there is no difference and the NRC experience demonstrates the problems of trying to separate them.

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4 Conversation with Jordan Lewis, Director, ETIP, September 21, 1976.

5 Letter from Philip Harter to Lester Rodgers, Director, Office of Regulatory Standards, Atomic Energy Commission, February 1, 1974.

6 Notes by Philip Harter, September 11, 1974.

7 Conversation with Richard Penn, Director Special Projects, ETIP, December 22, 1976.

8 Conversation with Marie Van Wyk, December 7, 1976.

9 Conversation with Roland Weiss, Operations Research Analyst, ETIP, September 6, 1976.

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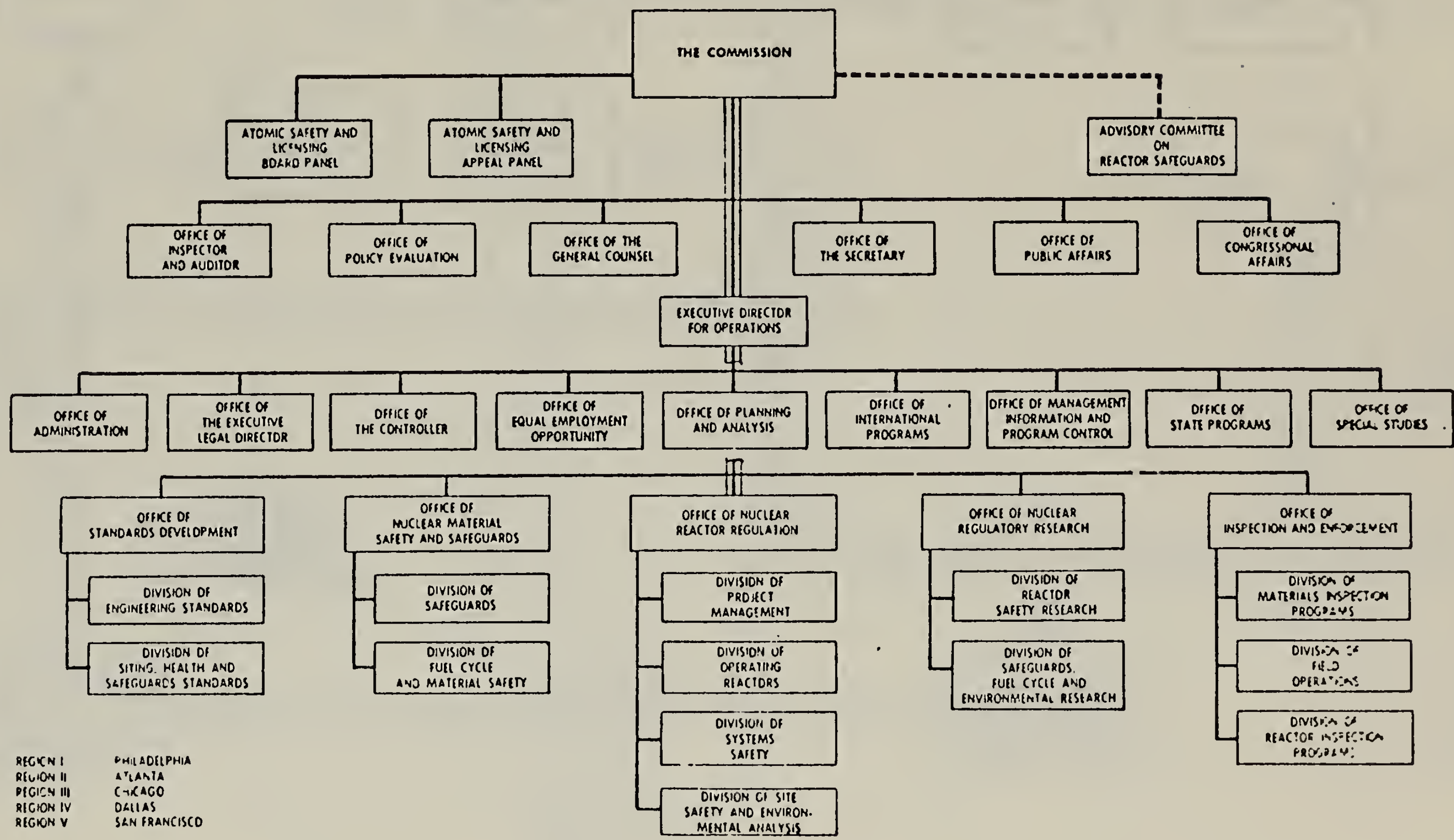
APPENDIX A

NUCLEAR REGULATORY COMMISSION *

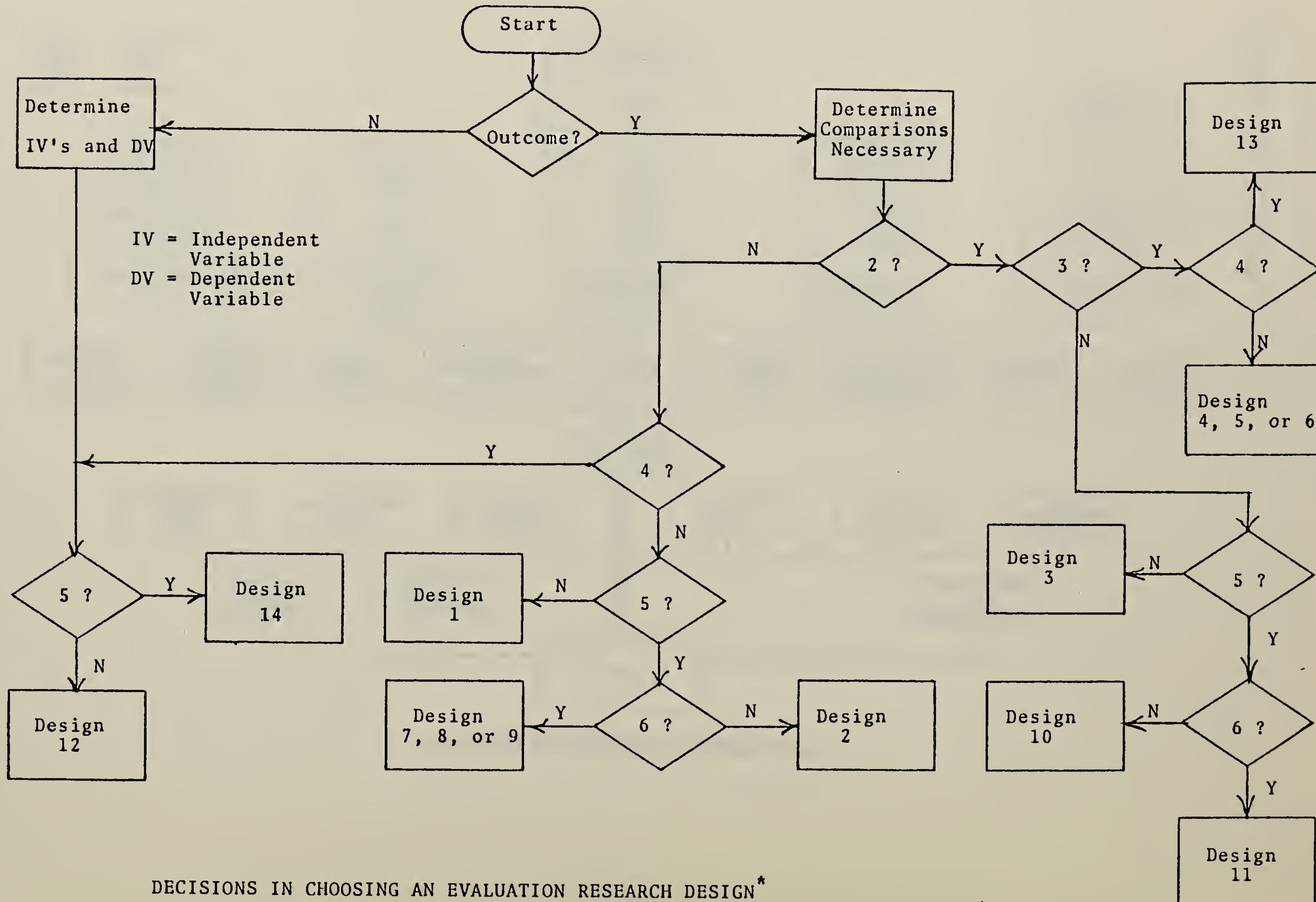


* This chart from the Office of the Federal Register, National Archives and Records Service, General Services Administration, <u>1976/77 United States Government Manual</u>, Washington, D.C.: Office of the Federal Register, May 1, 1976, p. 587.

APPENDIX B

Hierarchy of Questions

1. Which type of evaluation is needed?
2. Can control groups be used?
3. Is random assignment possible?
4. Can separate samples be used at all?
5. Are repeated measurements possible?
6. Are more than pre- and post-measurements possible?



DECISIONS IN CHOOSING AN EVALUATION RESEARCH DESIGN*

* This chart and the following pages of APPENDIX B are from Anderson, 1971, pp. 50, 45, 41 - 43.

Table 3.1

Strengths and Weaknesses of Research Designs

Parameters / Designs	Hist.	Mat'n.	Test'g.	Instr.	Regr.	Sel'n.	Mort.	Int.	Int.-Test,X	Int.-Sel.,X	React.	Mult.X
	Internal								External			
1.	-	-				-	-			-		
2.	-	-	-	-	?	+	+	-	-	-	?	
3.	+	?	+	+	+	-	-	-		-		
4.	+	+	+	+	+	+	+	+	-	?	?	
5.	+	+	+	+	+	+	+	+	+	?	?	
6.	+	+	+	+	+	+	+	+	+	?	?	
7.	-	+	+	?	+	+	+	+	-	?	?	
8.	+	+	+	+	+	+	+	+	-	?	-	-
9.	+	+	+	+	+	+	+	+	-	?	?	-
10.	+	+	+	+	?	+	+	-	-	?	?	
11.	+	+	+	+	+	+	+	?	?	?	?	-
12.	-	-	+	?	+	+	-	-	+	+	+	
13.	+	+	+	+	+	+	+	-	+	+	+	
14.	+	+	+	+	+	+	+	+	-	-	?	
15.	depends on what steps are taken to "patch up" the initial design											
16.	+	+	+	?	+	+	?	+	+	-	+	+

A minus indicates a weakness; a plus indicates that the design controls for that threat; a question mark indicates a possible source of concern; and a blank indicates that the factor is irrelevant. (from Campbell and Stanley, 1966, pp. 8, 40, and 56)

Campbell and Stanley (1966) discuss 16 social science research designs and describe which of the above threats to validity each falls prey to. Their list of research designs is as follows:

1. One shot case study: a single group is studied only once, after exposure to the treatment of interest --

   X 0

   treatment observation

2. One group, pretest and posttest: a single group is observed before and after --

   0 X 0

3. Static group comparison: two groups are studied (one after treatment, one after no treatment) --

X	0_1
	0_2

4. Pretest-Posttest Control group design: two randomly constructed groups are studied (one before and after treatment, one before and after no treatment) --

	R	0_1	X	0_2
randomized	R	0_3		0_4

5. The Solomon Four-group design: four randomly constructed groups are studied (two before and after, one not receiving treatment, and two after, one not receiving treatment) --

R	0_1	X	0_2
R	0_3		0_4
R		X	0_5
R			0_6

6. The Posttest-only control group design: two randomly constructed groups are studied (one after treatment, one after no treatment) --

R	X	0_1
R		0_2

7. The time-series experiment: one group is measured repeatedly, a treatment being administered sometime --

   0_1 0_2 ... X ... 0_n

8. The equivalent time-samples design: one group is measured with randomly alternating exposure to similar occasions --

$X_1 0 \quad X_0 0 \quad X_1 0 \quad X_0 0$

Occasion with treatment present

Occasion without treatment present

9. The equivalent materials design: one group is measured repeatedly with exposure to equivalent samples (a-d) of materials --

$M_a X_1 0 \quad M_b X_0 0 \quad M_c X_1 0 \quad M_d X_0 0$

material sample

10. The nonequivalent control group design: two groups (not pre-experimentally equivalent) are measured before and after --

0	X	0
0		0

11. Counterbalanced design: two or more groups are exposed to different treatments at different times --

	Time 1	Time 2	Time 3	Time 4
Group A	$X_1 0$	$X_2 0$	$X_3 0$	$X_4 0$
Group B	$X_2 0$	$X_4 0$	$X_1 0$	$X_3 0$
Group C	$X_3 0$	$X_1 0$	$X_4 0$	$X_2 0$
Group D	$X_4 0$	$X_3 0$	$X_2 0$	$X_1 0$

12. The separate-sample pretest-posttest research design: two randomly chosen groups are measured (one initially, one after treatment) --

R	0	(X)		irrelevant treatment
R		X	0	

13. The separate-sample pretest-posttest control group design: four randomly chosen groups are measured (two initially, one after treatment, one after no treatment) --

R	0	(X)	
R		X	0
R	0		
R			0

14. The multiple time-series design: two similar groups are measured repeatedly, the treatment being administered to only one --

$$\begin{array}{cccccc} 0 & 0 & \ldots & X & \ldots & 0 \\ 0 & 0 & & \ldots & & 0 \end{array}$$

15. The recurrent institutional cycle design: a "patched up" design: specific design features are added to control for variables noticed to be threats to validity once the study is underway. An example --

$$\begin{array}{cccc} X & 0_1 & & \\ & 0_2 & X & 0_3 \end{array}$$

16. Regression-discontinuity analysis: an "award (scholarship, admission to university, etc.) is given to certain members (chosen for high achievement for example) and then only that group is measured to see if the treatment (the award) made a difference:

$$0_{all} \rightarrow S \rightarrow X_s \quad 0_s$$

selection for the award — award to those selected — measurement only of those selected

Three tables are included in the original work to show how each of the designs "scores" on the threats to both internal and external validity. The three are summarized in Table 3.1, which has plus signs to show the strengths of the designs and minus signs to indicate weaknesses (or threats to validity).

At this point, the evaluator has determined which alternative research designs are possible for his use. Now he must decide how he will collect data from the group(s) to be studied. He has two main possibilities: to use data already collected and available in records or to administer some sort of measurement instrument himself. The former has an advantage of being non-reactive: that is, it does not

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APPENDIX C

CHRONOLOGY OF EVENTS

DATE	EVENT
September 26, 1973	Lester Rodgers, Director of Office of Regulatory Standards, AEC, testifies before Joint Committe on Atomic Energy, U.S. Congress, on the role of regulatory standards in nuclear safety.
February 1, 1974	Letter from Philp Harter, Chief, Regulatory Program, ETIP, to Lester Rodgers confirming interest in an experiment.
March 21, 1974	ETIP completes a project plan for the NRC experiment.
April 17, 1974	Project plan is sent to AEC.
April 25, 1974	ETIP submits further changes in project plan to AEC.
April 29, 1974	AEC formally expresses to ETIP interest in a joint ETIP-AEC project.
May 7, 1974	ETIP informs AEC of intent to proceed with the project.
May 16, 1974	NBS forwards project plan to Assistant Secretary for Science and Technology, Department of Commerce, for approval.
May 23, 1974	The Assistant Secretary for Science and Technology, Department of Commerce, approves the plan.
June 12, 1974	ETIP advances project funds to AEC.
August 28, 1974	Battelle-Northwest submits a proposal to the American National Standards Institute (ANSI) for conducting the NRC experiment.
September 10, 1974	First meeting of N635 committee. The committee is organized, the content of the standard discussed, and the work assignments made.

DATE	EVENTS
September 23-24, 1974	First meeting of N15.28 Committee
October 15, 1974	Battelle begins work. Scope of standard written.
October 29, 1974	Harlan Anderson submits a proposal to ANSI for conducting a similar experiment with another stnadards committee.
November 1, 1974	Nuclear Technical Advisory Board (NTAB) of ANSI meets. Battelle presents description of the experiment. The ad-hoc NTAB-ETIP committee given responsibility to select standards to developed. NTAB indicates some discomfort with experimenta design.
November 7, 1974	NTAB advises Battelle of three standards to be developed.
November 7&8, 1974	Second meeting of N635. Committee. The approach to writing the standard is discussed, assignments made, and a schedule developed.
November 26, 1974	ANSI informs Anderson of proposal acceptance.
December 18, 1974	Battelle report #1. Recruitment of N231 committee in progress. N635 Committee already organized and assignments made.
December 31, 1974	Lester Rodgers, Director of the Office of Regulatory Standards, AEC, retires.
January 9, 1975	ANSI requests a representative from ETIP for an ex-officio position on the ad hoc ANSI-ETIP committee.
January 15, 1975	Executive order issued establishing the Nuclear Regulatory Commission (NRC) from AEC (effective January 19).
January 24, 1975	ETIP reviews payment system due to ANSI feedback about delays.
January 25, 1975	TAD comments on experiment received indicating several weaknesses of experiment.

DATE	EVENT
January 27-31, 1975	Third meeting of N635 committe held at Battelle. A Draft 1, Revision 0 is produced.
February 3, 1975	ETIP suggests a representative for ad hoc ANSI-ETIP committee to ANSI.
February 12, 1975	Second meeting of N15.28 committee. Writing assignments were made and criteria for the standard discussed.
March 25, 1975	A project plan for ETIP Project #95, evaluation of the experiment, is completed at ETIP.
April 7-11, 1975	Third meeting of N15.28 committee held at Battelle. Draft 0, Revision 3, is produced.
April 18, 1975	The Assistant Secretary for Science and Technology, Department of Commerce, approves the project plan for ETIP Project #95.
April 25, 1975	NRC is informed of Project #95 approval from ETIP.
April 28-May 2, 1975	First meeting of N231 committee held at Battelle. The outline for the draft was revised and assignments made.
May 6, 1975	Fourth meeting of N635 committee. Comments on Draft 1, Revision 0 reviewed and draft prepared for submission to outside groups.
May 13, 1975	NTAB meeting which was to have discussed Project #95, but not accomplished.
May 21, 1975	Fourth meeting of N15.28 committee. Comments on Draft 0, Revision 3, are reviewed and changes agreed to.
June 16, 1975	ETIP funds for Project #95 are obligated to NRC.

DATE	EVENTS
	Fifth meeting of N15.28 committe. Draft 0, Revision 4 was discussed. These comments were reviewed until the end of July.
July 2, 1975	ANSI not yet received the evaluation contract for Project #95.
July 9, 1975	Delivery date for Project #47 experiment extended to December 30, 1975.
August 1, 1975	Evaluation contract for Project #95 still in NRC contracting office.
August 20, 1975	Chairman of ad hoc ETIP committee changed. Ralph Chalker resigns and Robert Davidson assumes chairmanship.
September 1975	Battelle submits final report to ANSI for Project #47.
September 1, 1975	N231 committee prepares Draft 1, Revision 0 but does not yet submit for outside comment.
December 2, 1975	NRC sends invitation to ANSI for the conduct of Project #95, the evaluation.
January 23,28, 1976	ANSI sends out invitation to potential contractors for conduct of the evaluation.
January 30, 1976	Three proposals submitted to ANSI for conduct of the evaluation.
February 3, 1976	ETIP contacts NRC to express displeasure with the process of contracting the evaluation and need to keep ETIP informed.
February 11, 1976	ANSI sends response to NRC invitation for the Project #95 evaluation.
February 27, 1976	Harlan Anderson submits final report on C-26 committee to ANSI.
March 26, 1976	NRC still has not signed a contract with ANSI. New project manager at ANSI.

DATE	EVENT
June 14, 1976	ANSI sends second response to NRC invitation for PROJECT #95 incorporating new components based on ANSI-ETIP discussions.
July 21, 1976	NRC and ETIP staff meet to discuss experiment and evaluation. NRC express desire that ETIP take control of the evaluation effort.
September 2, 1976	NRC formally requests that ETIP recall the evaluation fudns and manage the effort.
November 3, 1976	ETIP informs NRC that the funds obligated for Project #95 are to be rescinded.
Novmeber 29, 1976	Project #95 deobligated at ETIP.
December 16, 1976	Project #47 deobligated at ETIP.

APPENDIX E

EXPERIMENTS #1 THRU 3

APPENDIX E

Experiment #1: ANS 2.12 (ANSI N635) Guidelines for Combining Natural Phenomena and Manmade Hazards at Power Reactor Sites

Sponsoring interest group: American Nuclear Society (ANS)

Variables tested: Working meeting; draft of standard prepared and distributed by executive secretary; executive secretary provided; clerical and duplicating support provided; preliminary meetings held; committee size limited (to 11)

Sequence of events:

- Two meetings conducted before experiment started
  - First meeting organizational, assignments made (September, 1974)
  - Second meeting used to design overall writing approach; members assigned to task groups, tentative schedule made (November, 1974)
- Five-day working session held in January, 1975
  - Four members not in attendance
  - Secretary compiled draft sections written by individuals into working paper as starting point
  - Draft standard completed during course of week
  - Agreement made to incorporate final day's changes as the next revision
- Fourth meeting held in May, 1975 to review comments on draft
  - Group agreed that draft ready for review outside the group
  - Draft copies were sent for review to committee members and to group of outside experts

Outcomes:

- Standard cleared by appropriate American Nuclear Society committee in May, 1977

- Standard sent out for ballot by ANS members in December, 1977

- Standard submitted to ANSI in October, 1977, and sent out for public review and comment (concurrent with ANS membership review)

- Writing group met in February, 1978 to resolve comments; writing group response out to ANS and ANSI by April, 1978

- ANS membership approved standard

- ANSI approved as American National Standard in July, 1978

- NRC received copy for review and comment on August 8, 1978

- NRC sent comments back to ANSI committee on November 6, 1978.

<u>Experiment #2: INMM-11 (ANSI N15.28) Criteria and Standards for the Certification of Nuclear Materials Managers</u>

Sponsoring interest group: Institute of Nuclear Materials Management (INMM)

Variables tested: Working meeting; outline of standard prepared and distributed; executive secretary provided; clerical and duplicating support provided; chairman paid; travel and living expenses paid; preliminary meetings held; committee size limited (to 9)

Sequence of events:
- -- One meeting held before experiment started
- -- Two-day meeting held September, 1974: scope of standard was drafted; discussion
- -- One-day meeting held in February, 1975: discussed philisophical background; writing assignments made
- -- Five-day working session held in April, 1975
  - -- Two members not in attendance, and three were alternates
  - -- Rudimentary outline of standard distributed to members before meeting as starting point
  - -- Draft standard completed during course of week; some sections incomplete
  - -- Agreement made to incorporate final day's changes as the third revision; chair agreed to draft incomplete sections after received clean draft
- -- Fourth meeting held in May, 1975 to review comments on draft (five attended): changes agreed upon for next draft
- -- Fifth meeting held June, 1975 (seven attended): distributed/discussed, draft and agreed upon submission to INMM
- -- Draft sent to INMM Executive Committee to review
- -- Writing group chair and other member review Execitive Committee comments, incorporate into revised draft by end of July, 1975
- -- Revised draft sent to writing group, designated reviewers and INMM Executive Committee for review
- -- Draft completed by November, 1975

Outcomes:
- -- Standard submitted to ANSI in February, 1976
- -- Standard withdrawn for revision in July, 1976

Discussion: When the standard was sent out by ANSI for public comment, there was so much comment that the standard was premature (because the state of knowledge was insufficiently far advanced) that the standard was withdrawn.

Experiment #3: ANS 18.6 (ANSI N231) Discharge of Thermal Effluents Into Surface Waters

Sponsoring interest group: American Nuclear Society (ANS)

Variables tested: Working meeting; draft of standard prepared and distributed by chairman; executive secretary provided; clerical and duplicating support provided; chairman paid; travel and living expenses paid; committee size limited (to 10)

Sequence of events:
- No meetings held before experiment started
- Chairman drafted preliminary draft and distributed to members two weeks before working meeting; working assignments made before meeting
- Five-day working session held in April, 1975
  - All members were in attendance, with one an alternate
  - First step was major revision of preliminary outline
  - Two draft revisions written and reviewed
  - Agreement reached that furthèr work needed before submission for outside review, and work assignments made
- Assignments to members not received as of August, 1975

Outcomes:
- Draft never submitted for public review

Discussion: All environmental standards of ANSI's Committee N-19 (the ANSI recipient committee for this standard) are in the process of reevaluation, because of problems getting them through the ANSI public review process. (Extensive commentary on the environmental issues is stopping approval of all environmentally-related standards.) ANSI review of the Committee's standards has thus been suspended.

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☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

As part of its program on regulatory experimentation, the Experimental Technology Incentives Program conducted a project with the Nuclear Regulatory Commission on accelerating the standards development process. This report assesses the execution and outcomes of the project with a specific focus on whether further work is needed on the project and on how to improve future experimental designs. The report includes sections on agency and project background, project initiation, project plans, what actually happened, what was learned about the standards development process, and factors to consider in the design of other experiments.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Administrative experimentation; evaluation; Experimental Technology Incentives Program; nuclear regulatory standards; regulatory experimentation

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